# 1981 C.B. ANNUAL REPORT

## VOLUME 1

## SUMMARY OF DEVELOPMENT ACTIVITIES, COSTS AND ENVIRONMENTAL MONITORING


CATHEDRAL BLUFFS SHALE OIL COMPANY

751 HORIZON COURT

GRAND JUNCTION, COLORADO 81501



APRIL 30, 1982

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April 30, 1982



Submitted by:

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Up With People cast members, representing 23 countries, take the audience on a musical tour of the world featuring colorful and authentic songs and dances. Cathedral Bluffs sponsored shows of this group in Grand Junction on September 22 and in Rifle, Colorado on September 23, 1981.

## FOREWORD

The 1981 C.B. ANNUAL REPORT is submited to fulfill the requirements of Oil Shale Lease Number C-20341 as stated in Section 16(b) of the Lease, Section 1.(C)(4) of the Lease Environmental Stipulations, and Condition of Approval (No. 3) of the Detailed Development Plan issued on August 30, 1977. This report consists of the following volumes:

Volume 1 - Summary of Development Activities, Costs and Environmental Monitoring

Volume 2 - Environmental Analysis

Volume 2A - Volume 2 Supporting Data

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1981 C.B. ANNUAL REPORT

VOLUME 1

# SUMMARY OF DEVELOPMENT ACTIVITIES, COSTS AND ENVIRONMENTAL MONITORING

## 1.0 INTRODUCTION AND SUMMARY

This report summarizes the development activities, costs, and environmental monitoring on the Federal Oil Shale Lease Tract C-b during calendar year 1981. The Tract is leased to Occidental Oil Shale, Inc. under U.S. Department of Interior Lease Number C-20341. It is managed by the equal-interest partnership between Occidental and Tenneco Shale Oil Company, doing business as Cathedral Bluffs Shale Oil Company. The Tract is located in Rio Blanco County in the Piceance Creek basin of northwestern Colorado.

The project schedule for 1982 contained herein reflects the December, 1981 announcement that the entire project was being reassessed in view of current increased construction costs, reduced oil prices and high interest rates. Project expenditures in 1981 were approximately $76,500,000, a 26 million dollar increase over 1980.

Principal activities in 1981 were the continuation and completion of the sinking of three major mine shafts, initiating the outfitting of headframes for two of these shafts and expansion of the water management program to treat and dispose of waters associated with mine dewatering.

Shaft sinking in the 29-foot-diameter Production Shaft progressed from the 1,606 foot level at year-end 1980 to a terminal depth of 1,867 feet by end of September, 1981. The 34-foot-diameter Service Shaft reached a terminal depth of 1,758 feet by the end of April, 1981, 243 feet below the end-of-1980 level. Shaft sinking for the 15-foot-diameter Ventilation/Escape (V/E) Shaft progressed from a 1,302 foot level at year-end 1980 and reached a terminal depth of 1,617 feet in July. Outfitting both the Production and Service Shaft headframes is under way with completions estimated to occur prior to the end of July, 1982.

Water make from the shafts was as follows:

| Shaft | 1981 Year-End Water Make (gpm) | Total for 1981 ($10^6$ gal) | Cumulative Total to Date ($10^6$ gal) |
|---|---|---|---|
| V/E | 0 | 332 | 679 |
| Production and Service | 761 | 299 | 522 |
| TOTAL | 761 (1,613) | 631* (509) | 1,201 (570) |

Quantities for 1980 are shown in parentheses.

*3 X $10^6$ gal were also pumped from a small well for on-Tract use.

As of September 1, 1981 approval was obtained from the Oil Shale Office to inactivate the V/E Shaft dewatering pumps so as to allow the shaft to flood to temporarily alleviate pumping and discharge requirements. Peak monthly average pumping rate for the V/E Shaft in 1981 was 1,056 gpm achieved in January.

The surface water treatment facilities are designed to dispose of excess mine water which has been treated for both suspended solids and high pH by direct discharge from two lower ponds ("A" and "B") under NPDES permit, or by sprinkler irrigation, or by subsurface reinjection into aquifers of like water quality. This system was initiated in 1979 for direct discharge from Ponds A or B into Little Gardenhire Gulch, thence to Piceance Creek. Discharge is limited to 10% of the flow in Piceance Creek. In 1980 the sprinkler system was completed and tested utilizing a lateral distribution system on the ridge between Cottonwood and Sorghum Gulches. It was made operational shortly thereafter and continued in service during above-freezing weather into mid-October; it was again utilized for the months of June thru September of 1981. Peak capacity is about 450 gpm. For the reinjection system, tests were initiated in March, 1981 and completed in June at pumping rates up to 450 gpm. By September the reinjection mode was operationally available to replace the sprinkler system to become the principle mode of water treatment for the remainder of the year. To summarize for the year:

| | |
|---|---|
| $331 \times 10^6$ gal | were discharged from Ponds |
| $99 \times 10^6$ gal | were reinjected |
| $122 \times 10^6$ gal | were sprinkler irrigated |
| $82 \times 10^6$ gal | were used, evaporated, or leaked |
| $634 \times 10^6$ gal | were pumped. |

In 1981, three contractors' offices were added to the on-Tract facilities. Also added were the Mine Power Substation, a Natural Gas Supply Building, Sewage Treatment Plant, slabs for both the permanent Changehouse and the Warehouse Buildings, Manway Tunnels and Utility Tunnels. The 138 KV power line from Meeker to the Tract was completed in 1981. The temporary Service hoist and building were removed in 1981.

Twenty-four additional acres were disturbed in 1981 bringing the total to date to 188 (less than 4% of the Tract). These additions were twelve acres associated with the fill material area, five acres for additional topsoil storage, six acres for drill pads for reinjection wells and coreholes and one acre for raw shale embankment. The number of acres reclaimed was seven bringing the total revegetated acreage to 34; these included three acres of topsoil stockpile and four acres for drill pads of reinjection wells and coreholes. Total acreage of the raw shale storage pile is twelve acres, an increase of one acre over last year. It currently contains 126,000 cubic yards of raw shale.

Regarding environmental and health protection and control, in addition to water management already discussed, the following should be noted:

- Regarding air quality control, the baghouses on the cement batch plant still represent the only controlled point emissions source on Tract.

- No degradation in visual range has been noted since inception of the visibility program in 1975.

- A 9,000 gal/day capacity sewage treatment plant was placed in operation in March to treat 5,000 gal/day (average) sewage.

- 36 Reportable accidents in 956,636 man hours on tract resulted in an accident incident rate of 7.53.

- Special reflectors have been installed along several one-mile sections of Piceance Creek road as a mitigation test to reduce deer road kill.

The 1981 work force on Tract peaked at 685 in November with a year-end level of 600, up from the 1980 year-end level of 481. As of October when the most recent survey was made, 52% of the Tract employees lived in Rifle, 26% in Meeker, 19% in the Colorado River Valley and 3% miscellaneous. The C-b employee bus system was expanded to 10; approximately 60% of the work force utilized the buses. With four other oil shale projects, C.B. participated financially in the start of construction of a highway by-pass in Rifle. The project continued to lease 111 apartment units in Rifle and Meeker and to operate the 103 unit King's Crown mobile home park in Rifle. The project continues to support the Mitigation Task Forces in both Rio Blanco and Garfield Counties. In 1981 the Public Relations Department conducted 218 tours of the Tract, a 77% increase over 1980.

Environmental monitoring has continued as an ongoing activity at the Tract since the completion of the two-year Baseline period (1974-1976). It encompasses air, water, noise, photography, and biology as well as studies of ecosystem interrelationships, toxicology, and health and safety. Results are briefly summarized in Section 9 of this volume and extensively analyzed in Volume 2 of this Annual Report. No significant environmental impacts have been noted to-date except for areas directly disturbed by construction, ponds, and mined rock disposal, drawdown of groundwater levels from mine dewatering, and some vegetation effects in the sprinkler-irrigated areas.

For purposes of demonstrating compliance of this Annual Report with the Detailed Development Plan (DDP), the Development Monitoring Plan (DMP) (both of which imply compliance with the Lease), and the Water Court Decree #W-3492 (leading to the Water Augmentation Plan (WAP), a Requirements Compliance Matrix is presented in Table 1-1 showing where information relating to these controlling documents is addressed in Volumes 1 and 2 of this Annual Report.

The following project abbreviations appear in this report:

C.B. - for Cathedral Bluffs, and
C-b - for Colorado-b Oil Shale Federal Lease Tract.

TABLE 1-1



Requirements Compliance Matrix

| Controlling Document | Document Section | Section Subject | Annual Report Volume 1 Section or Chapter | Annual Report Volume 2 Section or Chapter | Comments |
|---|---|---|---|---|---|
| DDP | Volume I Section I | General Information and Summary | 1, 2, 4, 7.11, 9 | 1.1 | |
| | Section II | Phase I - Mine Development | | | |
| | A. | Schedule & Summary | 3, 4 | 2.1 | |
| | B. | Manpower | 1, 8 | | |
| | C. | Engineering Design & Procurement | 3.2, 4, 5 | | |
| | D. | Mine Surface Facilities | 1, 3, 4 | | |
| | E. | Mine Shaft Sinking | 1, 3, 4, 7.2, 7.7 | | |
| | F. | Development Mine | | | |
| | G. | Utilities and Fuel | 4, 7.3, 7.9 | | |
| | H. | Crushing and Conveying | | | |
| | I. | Alternate Mining Methods | | | |
| | J. | Access and Service Roads | 4, 7.9 | | |
| | K. | Dams | | 5.2.6, 5.3.6 | |
| | L. | Coarse-Ore Conveyor & Stockpile | | | |
| | M. | Shaft Dewatering, Treatment & Disposal | 4.1.10, 7.2 | 5.2.6, 5.3.6, 5.3.7 | |
| | Section III | Phase II - Plant Construction | 5 | | |
| | A. | Summary | 4 | | |
| | B. | Schedule & Manpower | 3, 8 | 2.1 | |
| | C. | On-Tract Surface Facilities | 4 | | |
| | D. | Off-Tract Facilities | 4 | | |
| | Section IV | Phase III & Phase IV | | | Not at this Phase of Development yet. |
| | A. | Summary - Phase III | | | " " " " " " " |
| | B. | Schedules and Manpower | | | " " " " " " " |
| | C. | Mine Operations | | | " " " " " " " |
| | D. | Crushing and Conveying | | | " " " " " " " |
| | E. | Retorting and Upgrading | | | " " " " " " " |
| | F. | Waste Disposal | | | " " " " " " " |
| | G. | Water Use | | | " " " " " " " |
| | H. | Electric Power Use | | | " " " " " " " |
| | I. | Utility Systems | | | " " " " " " " |
| | J. | Pipelines | | | " " " " " " " |
| | K. | Phase IV - Post Operations | 7.10 | | " " " " " " " |

| Controlling Document | Document Section | Section Subject | Annual Report Volume 1 Section or Chapter | Annual Report Volume 2 Section or Chapter | Comments |
|---|---|---|---|---|---|
| DDP | Section V | Environmental Control Plans | 9, 7, 1 | | |
| | A. | Air Pollution Control | 7.1, 9.3.5 | 1.2.5, 1.2.6, 6.0 | |
| | B. | Water Pollution Control | 1, 7.2 | 1.2.3, 5.1, 5.2.6, 5.3.6 | |
| | C. | Noise Control | 7.7.2, 9.3.7 | 1.2.7, 7.0 | |
| | D. | Protection of Historic, Scientific & Aesthetic Values | 7.6, 9.3.11 | 1.2.11 | |
| | E. | Fire Prevention & Control | 1, 7.7.3 | | |
| | F. | Health and Safety | 1, 7.7, 9.3.12, 9.3.13 | 1.2.12, 1.2.13, 10.0 | |
| | G. | Overburden Management | 6 | 8.9 | |
| | H. | Processed - Shale Disposal | 6 | | |
| | I. | Disposal of Other Wastes | 4, 6, 7.4 | | |
| | J. | Fish and Wildlife Management | 7.8, 9.3.4, 9.38 | 1.2.4, 1.2.8, 8.0 | |
| | K. | Erosion Control and Surface Rehibilitation and Revegetation | 6, 7.5, 9.3.9 | 1.2.9, 8.9 | |
| | L. | SPCC Plan | 7.3 | | |
| | M. | Off-Tract Corridors | 7.9 | | |
| | Section VI | Environmental Monitoring | 1, 9 | 1.1, 1.2 | |
| | A. | Introduction | 1, 9 | 1.1 | |
| | B. | Soils Survey and Productivity Assessment | 9 | 8.7, 8.8 | |
| | C. | Surface Water | 1, 4, 7.2, 9.3.3 | 1.2.3, 5.2.1, 5.2.2, 5.2.6, 5.3.1, 5.3.2, 5.3.6, 5.3.9 | |
| | D. | Sub-surface Water | 1, 4, 9.3.3 | 1.2.3, 5.2.3, 5.2.4, 5.2.5, 5.2.6, 5.2.8, 5.3.2, 5.3.3, 5.3.4, 5.3.5, 5.3.6, 5.3.7, 5.3.9 | |
| | E. | Meteorology and Air Quality | 1, 7.1, 9.3.5,9.3.6 | 1.2.5, 1.2.6, 4, 6.0 | |
| | F. | Biological | 1, 6, 9.3.4, 9.3.8, 9.3.9, 7.8 | 1.2.4, 1.2.8, 1.2.9, 8.0 | |
| | G. | Noise | 7.7.2, 9.3.7 | 1.2.7, 7.0 | |
| DMP | Section 1 | Introduction | 2, 9.1, 9.2 | 2.1 | |
| | 2 | Milestones & Maps | 3.1, 9.2, 9.3 | 2.1 | |
| | 3 | Photography | 1, 9.3.2 | 1.2.2, 4.0 | |
| | 1.1 | Surface | 1 | 4.1 | |
| | 1.2 | Aerial | 1, 4.3.10 | 4.2 | |
| | Section 4 | Indicator Variables | 1, 9.3.1, 9.3.10 | 3.0, 1.2.1 | |
| | 5 | Hydrology | 1, 7.2, 9.3.3 | 1.2.3, 2.2, 5 | |
| | 5.2 | Surface | 1, 4, 7.2, 9.3.3 | 5.2.1, 5.2.2, 5.2.6, 5.3.1, 5.3.2, 5.3.9 | |
| | 5.3 | Sub-Surface | 1, 4, 7.2, 9.3.3 | 5.2.3, 5.2.4, 5.2.5, 5.2.6, 5.3.3, 5.3.4, 5.3.5, 5.3.6, 5.3.7 5.3.9 | |
| | 5.4 | Development | 1, 4, 7.2 | 5.2.6, 5.2.8, 5.3.6, 5.3.7, 5.3.9 | |

| Controlling Document | Document Section | Section Subject | Annual Report Volume 1 Section or Chapter | Annual Report Volume 2 Section or Chapter | Comments |
|---|---|---|---|---|---|
| DMP | Section 5.5 | Systems Dependent | 1, 4, 7.2 | | |
| | 5.6 | Quality Assurance | 1 | 5.4 | |
| | 6 | Air Quality & Meteorology | 1, 7.1, 9.3.5, 9.3.6 | 1.2.5, 1.2.6, 6.0 | |
| | 6.2 | Ambient Air Quality | 1, 7.1 | 6.2 | |
| | 6.3 | Meteorology | 1, 7.1 | 6.3 | |
| | 6.4 | Development - Related | 1, 7.1 | | |
| | 6.5 | Systems Dependent | 1 | | |
| | 7 | Noise | 1, 7.7.2, 9.3.7 | 1.2.7, 7.0 | |
| | 8 | Biology | 1, 9.3.8, 9.3.9, 9.3.4 | 1.2.4, 1.2.8, 1.2.9, 8.0 | |
| | 8.2 | Big - Game Deer | 1, 9.3.8 | 1.2.8, 8.2 | |
| | 8.3 | Medium Sized Mammals | 1, 9.3.8 | 1.2.8, 8.3 | |
| | 8.4 | Small Mammals | 1, 9.3.8 | 1.2.8, 8.4 | |
| | 8.5 | Avifauna | 1, 9.3.8 | 1.2.8, 8.5 | |
| | 8.6 | Aquatic | 1, 9.3.4 | 1.2.4, 8.6 | |
| | 8.7 | Terrestrial | 1, 9.3.9 | 8.7, 1.2.9 | |
| | 8.8 | Threatened & Endangered | 1, 9.3.8 | 8.8 | |
| | 8.9 | Revegetation | 1, 6 | 8.9 | |
| | 8.10 | Systems Dependent | 1 | 8.10, 8.11 | |
| | Section 9 | Items of Historic, Prehistoric or Scientific Interest | 1, 9.3.11 | 1.2.11, 9.0 | |
| | 10 | Industrial Health & Safety | 1, 7.7, 9.3.12, 9.3.13 | 1.2.12, 1.2.13, 10.0 | |
| | 11 | Subsidence Monitoring | | 11.0 | |
| | 12 | Ecosystem Interrelationships | 9.3.10 | 12.0 | |
| | 13 | Data Management & Reporting | 9.1, 9.3.14, 9.3.15 | 1.2.14, 1.2.15, 13.0 | |
| Water Court Decree W-3493 | 7 | Legal Description of Site | 2 | 2.2 | |
| | 8 | Sources of Water Supply | 4 | 5.2.6 | |
| | 9, 10, 11 | Dewatering & Augmentation | 7.2, 9.3.3 | 5.2, 5.3 | |
| | 13 | Assignment of Upper & Lower Aquifer | | 5.2.4, 5.2.5, 5.3.4, 5.3.5, 5.2.3 | |
| | 19 | Evidence of Depletion Effects | 7.2, 9.3.3 | 5.2 | |
| | 24 | Monitoring Program | 7.2, 9.3.3 | All of Volume II | |
| | 25 | Parameters | | 3.2.2, 5.2, 5.3 | Exhibit A, wells, springs, seeps, streams, precipitation sites. Exhibit B, Development Monitoring Program. |
| | 26 | Timely Implementation Requirement | | 5.1 | |
| | 27 | Following Cone of Depression | | 4.2.2, 5.2.3, 5.2.4, 5.2.5, 5.2.6 | |
| | 28 | Monitoring Plan Modifications Provision | | 1.1 | |
| | 29 | Cone of Depression Determination & Monitoring | 9.3.3 | 5.2.5, 5.2.6 | |

| Controlling Document | Document Section | Section Subject | Annual Report Volume 1 Section or Chapter | Annual Report Volume 2 Section or Chapter | Comments |
|---|---|---|---|---|---|
| Water Court Decree W-3493 | 30 | Water Replacement | | 5.2.6 | |
| | 31 | Colony, Union Agreement | | 5.2.5 | |
| | 32-38 | Compensation for Depletions | | | |
| | 39-46 | Protection of Objectors Water Rights | | 5.2 | |
| | 47-50 | Court Retention of Jurisdiction | 7.2 | | |
| | 51-59 | Conclusions of Law | 7.2 | | |
| | 60-79 | Judgment and Decree | 7.2 | | |
| | 62 | Replacement Water | | 5.2.6 | |
| | 63 | Compensations to Well Water Right | | 5.2.6 | |
| | 71 | Replacement Water Quality | | | |
| | 73 | State Water Engineer - Conditions | | | |
| | 75 | Term Day Hearing Requirement | | | |
| | 76 | Augmentation Modification Provision | | | |

# 2.0 DESCRIPTION OF PROJECT AREA

## 2.1 Location

Federal Oil Shale Tract C-b is located in the Piceance Creek structural basin between the Colorado River on the south and the White River on the north. The basin is dominated by a large central plateau which represents more than 75 percent of the basin's land surface. The area represents a sparsely populated portion of the Rio Blanco County in northwestern Colorado. Terrain on the Tract consists primarily of undulating valleys and ridges trending in the northeasterly direction and draining into Piceance Creek. The northern edge of the Tract is approximately one-half mile south of Piceance Creek between Willow Creek and Stewart Gulch. West of the Tract Piceance Creek flows northwesterly approximately 24 miles to its confluence with the White River. Irrigated-grassland ranching predominates along Piceance Creek. The towns nearest to the Tract are Meeker (48 miles), Rifle (45 miles), and Rangely (65 miles).

Elevations on the Tract vary from 6,400 feet in the lowest valley bottoms to 7,100 feet on the ridges to the southern edge of the Tract. The climate is semiarid with snow cover occurring variably from October to May. The climate supports sparse vegetation, with sagebrush and pinyon-juniper communities being dominant. Historically, the Tract has been used primarily for cattle grazing and winter range for mule deer. As part of a BLM range improvement program, approximately 45 percent of the Tract (primarily the flat ridgetops) was chained in 1967. The technique was intended to improve range production by removing sage and pinyon-juniper.

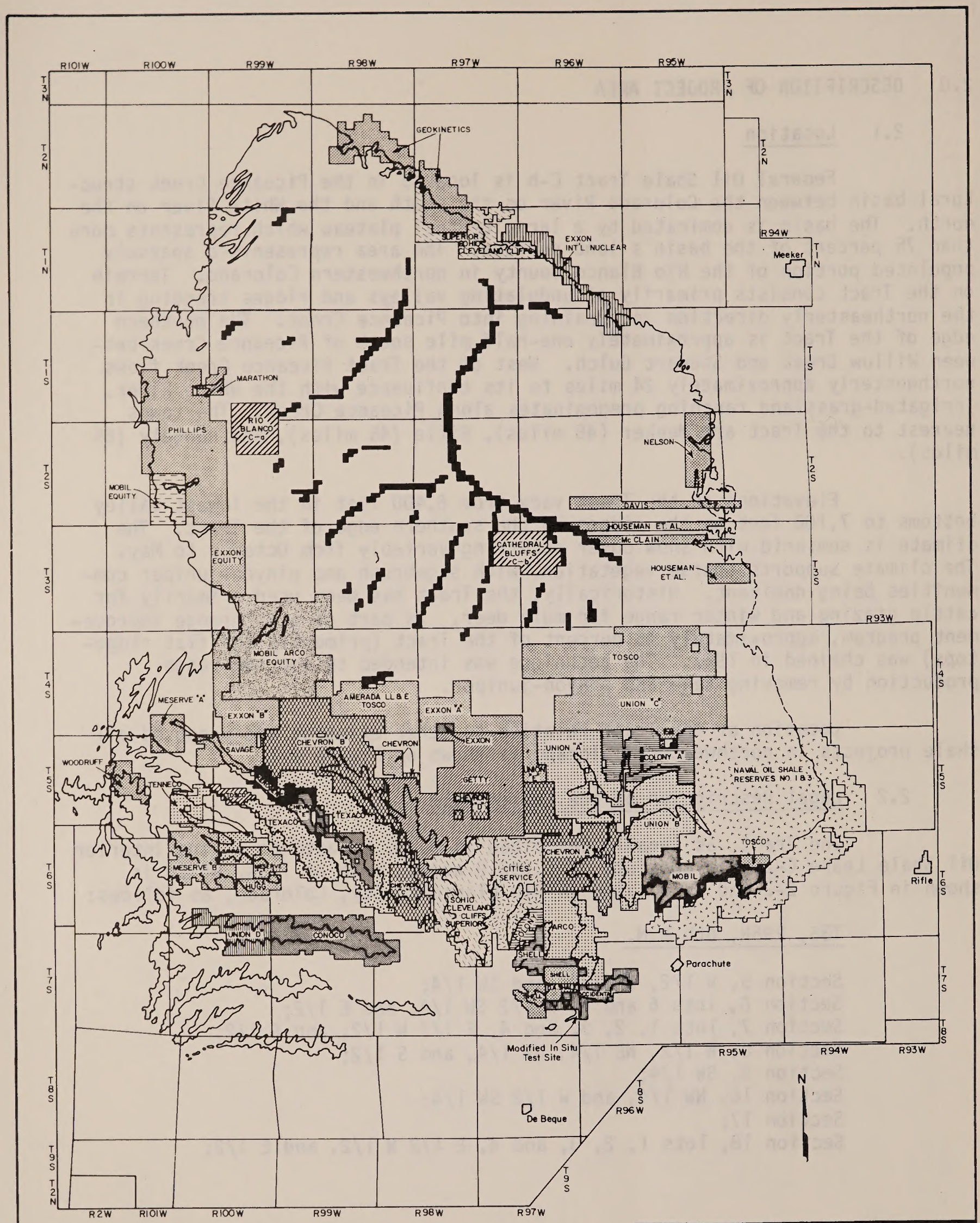
Location of the Tract relative to other existing and proposed oil shale projects in northwestern Colorado is shown on Figure 2-1.

## 2.2 Legal Description of the Leased Land

The Tract, as legally described in U. S. Department of the Interior Oil Shale Lease C-20341, consists of 5,093.9 acres, more or less, which is shown in Figure 2-2 and is located in Rio Blanco County, Colorado, as follows:

T3S, R96N, 6th P.M.

Section 5, W 1/2, SE 1/4, and SW 1/4;
Section 6, lots 6 and 7, E 1/2 SW 1/4, and E 1/2;
Section 7, lots 1, 2, 3, and 4, E 1/2 W 1/2, and E 1/2;
Section 8, W 1/2, NE 1/4, NW 1/4, and S 1/2;
Section 9, SW 1/4;
Section 16, NW 1/4, and W 1/2 SW 1/4;
Section 17;
Section 18, lots 1, 2, 3, and 4, E 1/2 W 1/2, and E 1/2;




## EXPLANATION

- Fee Lands (Ownerships not shown)
- TOSCO — Unpatented Oil Shale Mining Claims (Ownership posted)
- Patented Oil Shale Mining Claims (Various patterns used to accentuate posted ownership)
- Naval Oil Shale Reserve Lands
- Federal Oil Shale Leases
- Mahogany Marker Outcrop

NOTE: Undifferentiated Oil Shale Land is owned by Federal Government.

**Figure 2-1**
**OIL SHALE MINERAL RIGHT OWNERSHIP OF MAJOR LAND HOLDINGS NORTHERN PICEANCE BASIN NORTHWESTERN COLORADO**

1 2 3 4 5 6 Miles
SCALE

1981

T3S, R97W, 6th P.M.

Section 1, S 1/2;
Section 2, SE 1/4;
Section 11, E 1/2;
Section 12;
Section 13, N 1/2;
Section 14, N 1/2 NE 1/4.

## 2.3 Leasehold Status

The Lease requires that a Detailed Development Plan be developed prior to its third anniversary date. Such a plan was developed for underground mining and surface retorting in February, 1976. A plan modification to incorporate modified insitu retorting was prepared in February, 1977. This Annual Report, summarizing the operations conducted, is a requirement under the Detailed Development Plan.

Furthermore, the Lease stipulates that operations be conducted in compliance with all Federal, State and local regulations and laws. Lease Environmental Stipulations are set forth to protect the environment; the environmental monitoring program called Development Monitoring is consistent with these stipulations and forms part of the Detailed Development Plan. Volume 1 of this Annual Report summarizes the environmental program results and Volume 2 presents a discussion and analysis of this program.

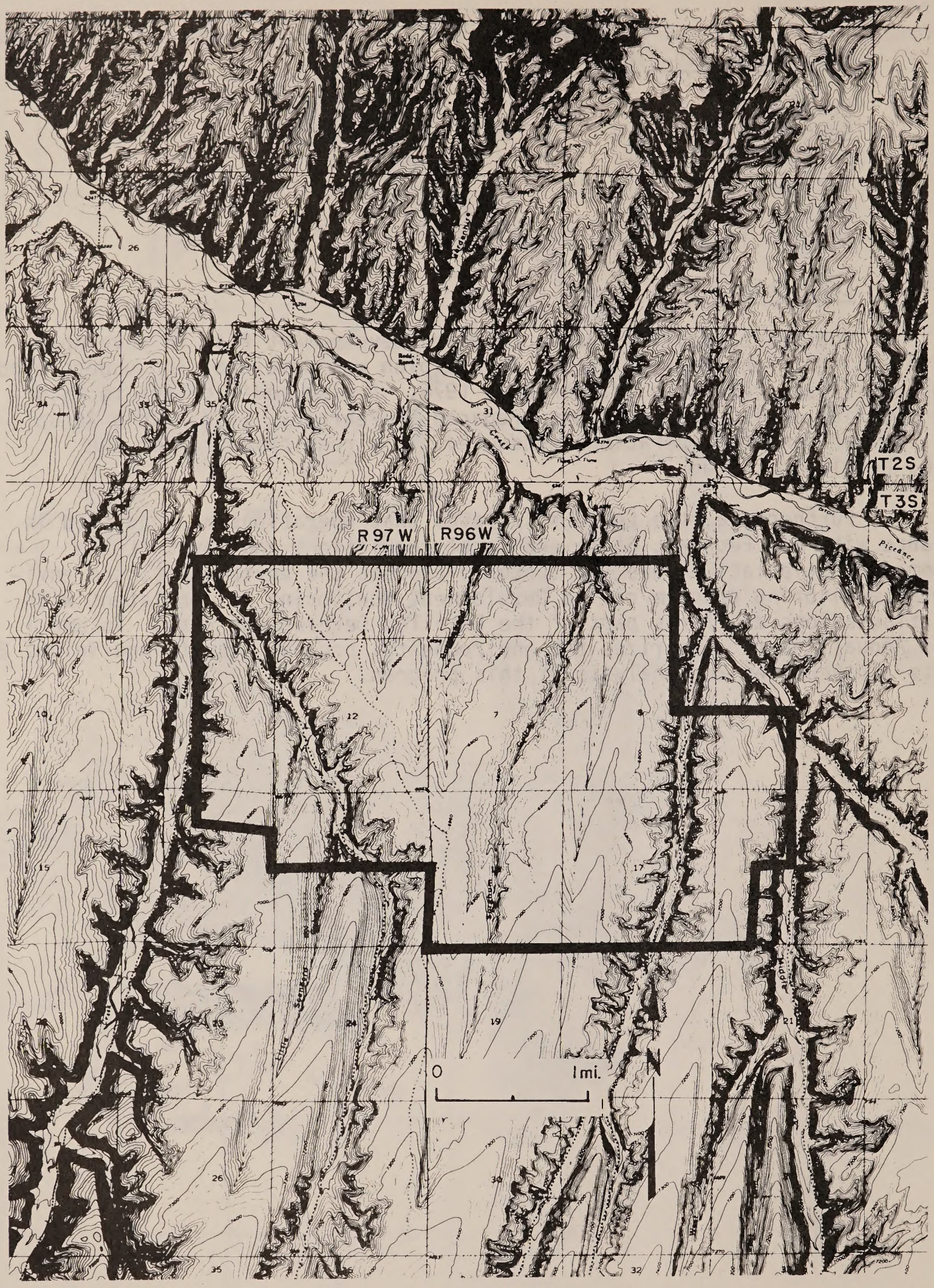



Figure 2-2
Location of tract C-b according to range, township and section

# 3.0 SCHEDULE AND COSTS

## 3.1 Schedule

### 3.1.1 "Milestone" Schedule

The "Milestone" schedule which has been approved by the OSO (and which appeared in last year's Annual Report) is given on Figure 3-1. On September 1, 1981 approval was granted by the OSO for an interim operation plan for the V/E Shaft following its completion and until mining is commenced from the Production and Service Shaft area. This plan involves allowing the V/E Shaft to fill with water under upset conditions (including mine water from all three shafts) until its is necessary to draw down the water for mine development. This plan and schedule are shown in Figure 3-2.

A near-term update of projected activities called an Interim Development Schedule is given on Figure 3-3. This projected schedule reflects the December, 1981 announcement by C.B. project management that the entire project was being reassessed due to excessive project costs. The primary goal of this revised schedule is to arrive at an optimized project configuration and to complete a design basis by the end of 1983.

### 3.1.2 Schedule vs. Actual Activities in 1981

Figure 3-4 shows how site-preparation and construction activities in 1977-1981 compared with the previously developed milestone schedule for this time span. Even though due diligence has been exercised some unavoidable schedule slippage has occurred.

The year 1981 represented the fourth full year of major construction development at the C-b Tract. This large scale effort, principally related to shaft sinking, shaft equipping and headframe outfitting involved many contractors. Project contractors and their area of responsibility are shown on Table 3-1.

## 3.2 Costs

Financial information for 1981 is presented in Table 3-2 for the following categories: field construction, engineering, operating costs, oil upgrading, environmental, other programs, general and administrative. Total costs compare with previous years as follows:

| YEAR | TOTAL COSTS |
|---|---|
| 1978 | $41,045,000 |
| 1979 | 29,971,500 |
| 1980 | 50,512,500 |
| 1981 | 76,534,000 |

Cost differences from last year are, by category:

| | |
|---|---|
| Field Construction | $+17.6 million |
| Engineering Costs | +4.2 |
| Operating Costs | +0.9 |
| Oil Upgrading | +0.7 |
| Environmental | -0.6 |
| Other Programs | -1.6 |
| General & Administrative | +4.8 |
| TOTAL | $26.0 |

In field construction the largest increase was for headframe costs (increase of $9.2 million).

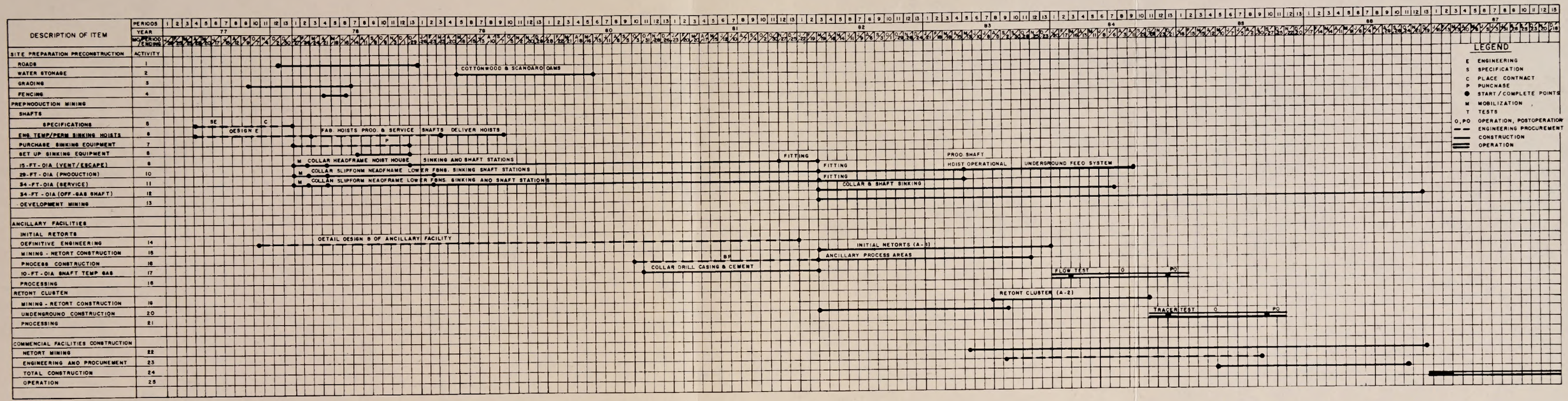



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FIGURE 3-1
OVERALL PROJECT GUIDE SCHEDULE

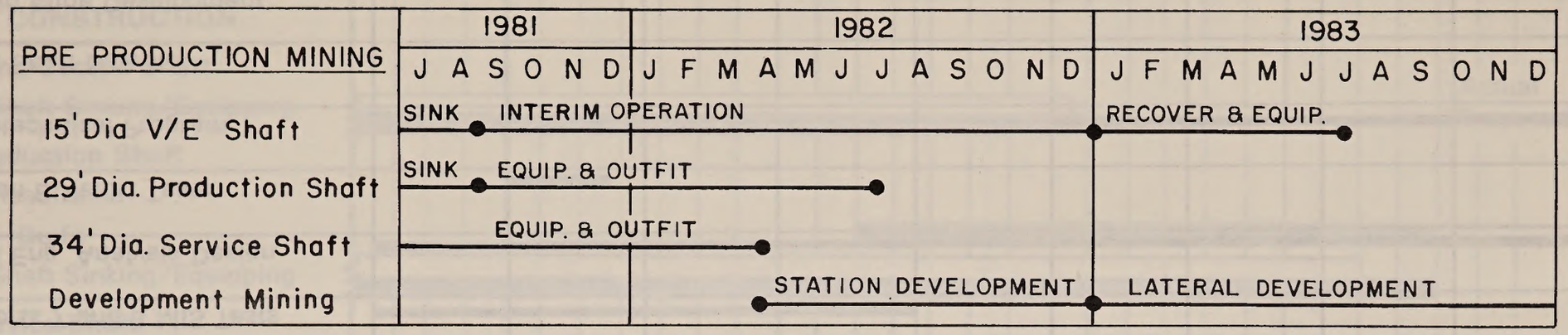



FIGURE 3-2

C.B. INTERIM DEVELOPMENT SCHEDULE — SHAFTS AND MINING

(Approved September 1, 1981)

| | 1Q '82 | 2Q '82 | 3Q '82 | 4Q '82 | 1Q '83 | 2Q '83 | 3Q '83 | 4Q '83 | 1Q '84 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Completion of Shaft Sinking | | | | | | | | | | |
| Headframe Outfitting | | | | | | | | | | |
| Production & Service Shaft Dewatering | | | | | | | | | | |
| Reinjection Continuation (11X18) | | | | | | | | | | |
| Site Operations & Maintenance | | | | | | | | | | |
| Reclamation Tests | | | | | | | | | | |
| Revised DDP | | | Prepare | | | | | Submit | | Approval |
| PSD Permit | | | | | | Prepare | | | Submit | |
| Engineering Analysis | | | | | | | | | | |
| Prepare Basis for Design | | | | | | | | | | |
| Retorts 7 and 8 MIS Tests | | | | | | | | | | |
| MIS Eng. Analysis-Design | | | | | | | | | | |
| Union B Retort Tests | | | | | | | | | | |
| Geotechnical Program | | | | | | | | | | |
| V/E Shaft Dewater | | | | | | | | | | 1985 |
| Begin Mine Development | | | | | | | | | | 1984 |
| Begin Surface Construction | | | | | | | | | | 1985 |

Figure 3-3. Interim Development Schedule

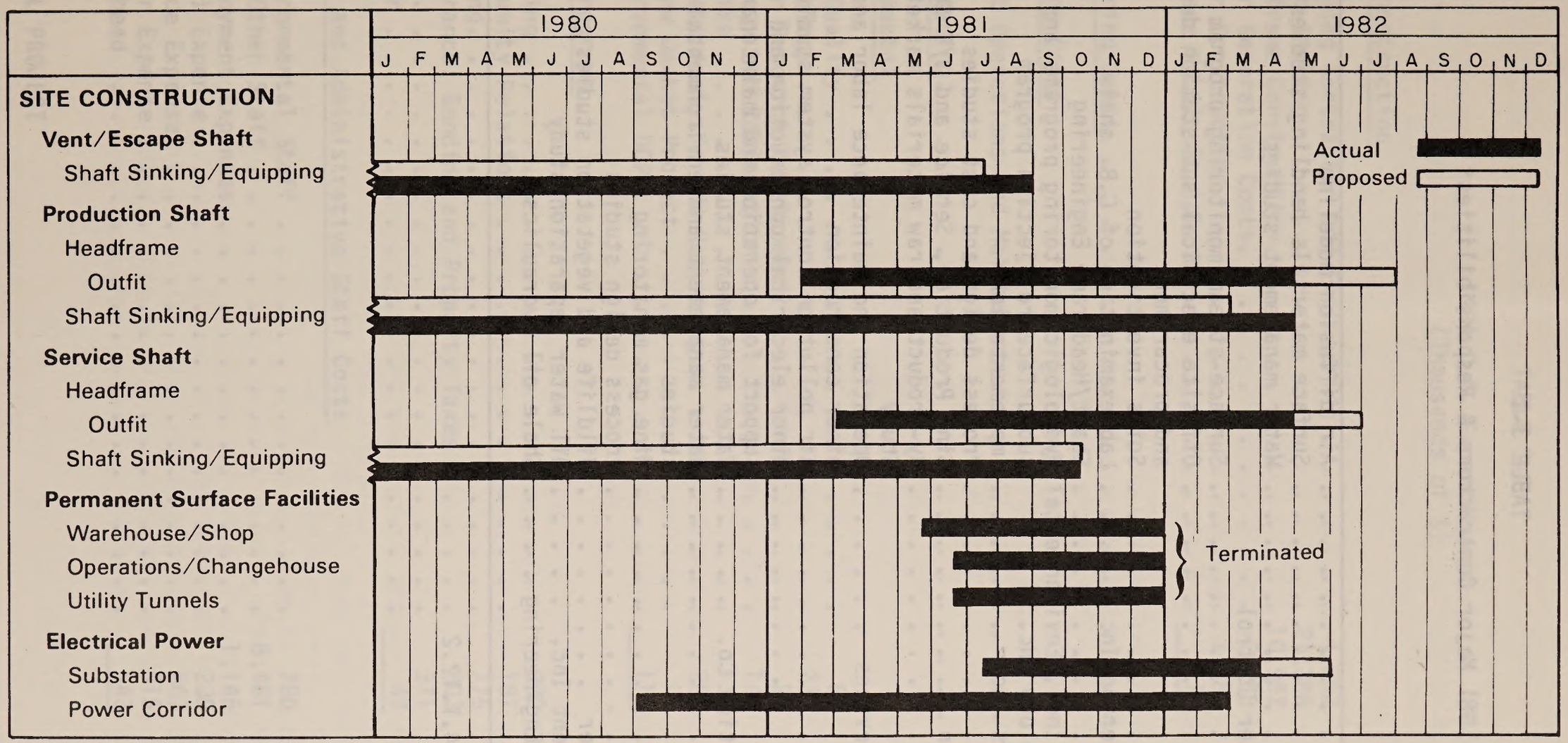



Figure 3-4
C.B. Construction Activities in 1980-1982

TABLE 3-1

1981 Major Contractors & Responsibilities*

| | |
|---|---|
| AeroVironment | Air diffusion modeling |
| Bechtel | Surface materials handling studies |
| Brown & Caldwell | Water management studies |
| Colorado River Water Control District | Surface-stream monitoring program |
| Colorado Ute | Off-site electrical sub-station design and procurement |
| Dames & Moore | Soils investigation |
| Development Engineering Inc | Lab examination of C.B. shale |
| Dravo | Shaft/Headframe Engineering |
| Energy Consultant Inc., Environmental Research & Technology Inc. Geothermal Surveys Inc. | Hydrologic monitoring programs and subsurface reinjection program implementation |
| Fluor | Process design and cost studies |
| Gilbert Corporation | Sink Production, Service and V/E Shafts |
| Arthur D. Little | By-product and raw materials marketing Study |
| Outoff Minerals Services | Operation and maintenance labor and minor construction |
| Parsons | Air pollution control system studies |
| Power Constructors | Minor electrical construction and support for operation and maintenance |
| Resources Conservation Co. | Water management studies |
| SRI International | Water management and environmental studies |
| Scott-Ortech | Mine gas monitoring |
| Stearns Roger | Process design studies |
| Stoecker & Keammerer | Wildlife and vegetation studies |
| Technology Management Inc. | Oil water separation study |
| Williams Brothers Engineering | Shale oil hydraulics |

*See also Section 4.1.12.2

TABLE 3-2

1981 C.B. Expenditures
(Thousands of $)

| | | |
|---|---|---|
| **Field Construction** | | |
| Managing Contractor and Engineering | 4,952 | |
| Shaft Sinking | 21,388 | |
| Headframe Construction | 10,987 | |
| Power Generation Costs | 2,253 | |
| Other Construction | 7,382 | |
| Surface Mobile Equipment | 172 | |
| | | 47,134 |
| **Engineering Costs** | | 10,078 |
| **Operating Costs** | | |
| Tract Operations and Maintenance | | 2,491 |
| **Oil Upgrading** | | 700 |
| **Environmental** | | |
| Air Quality | 61 | |
| Hydrology | 237 | |
| Water Resource Development | 26 | |
| Biology and Reclamation | 149 | |
| Permits | 131 | |
| Systems Analysis and Reporting | 222 | |
| Yellow Jacket Project | 2 | |
| Environmental DDP | 118 | |
| | | 944 |
| **Other Programs** | | |
| Housing | 232 | |
| Community Relations | 187 | |
| Busing | 775 | |
| Insurance, Bonding and Property Taxes | 803 | |
| Land | 371 | |
| Other | 47 | |
| | | 2,415 |
| **General and Administrative Staff Costs** | | |
| Environmental Staff | 780 | |
| All Other Staff | 8,481 | |
| Employment Expenses | 1,146 | |
| Legal Expense | 239 | |
| Office Expense | 667 | |
| Other Expense | 915 | |
| Overhead | 543 | |
| | | 12,771 |
| TOTAL PROJECT | | 76,534 |

# 4.0 DEVELOPMENT ACTIVITIES

This chapter describes 1981 development activities relative to on-Tract facilities in Section 4.1, off-Tract facilities in Section 4.2, access/service and support in Section 4.3 and mining in Section 4.4.

## 4.1 On-Tract Facilities Description

### 4.1.1 General Arrangement

Construction activities in 1981 consisted primarily of shaft sinking and initiating outfitting of the headframes. Also in 1981 construction of seven new surface support facilities has been accomplished.

In September, 1980, the entire Tract was overflown and photographed for contour mapping and mosaic preparation. Photographs were taken from two elevations to provide maps of the entire Tract on a 5-foot contour interval, 1:2400 scale. Mapping was completed in early February, 1981. Figure 4-1, (jacket map) is a 1:7200 Topographic Map from this map set which also shows the overall plot plan. Also indicated on this map are the locations of four areas shown at a scale of 1:2400 with the text as follows:

| | |
|---|---|
| Figure 4-2: | Mine Support Area |
| Figure 4-3: | V/E Shaft, Ponds A/B, and Heliport Area |
| Figure 4-4: | Pond C Area |
| Figure 4-5: | Explosives Storage Area |

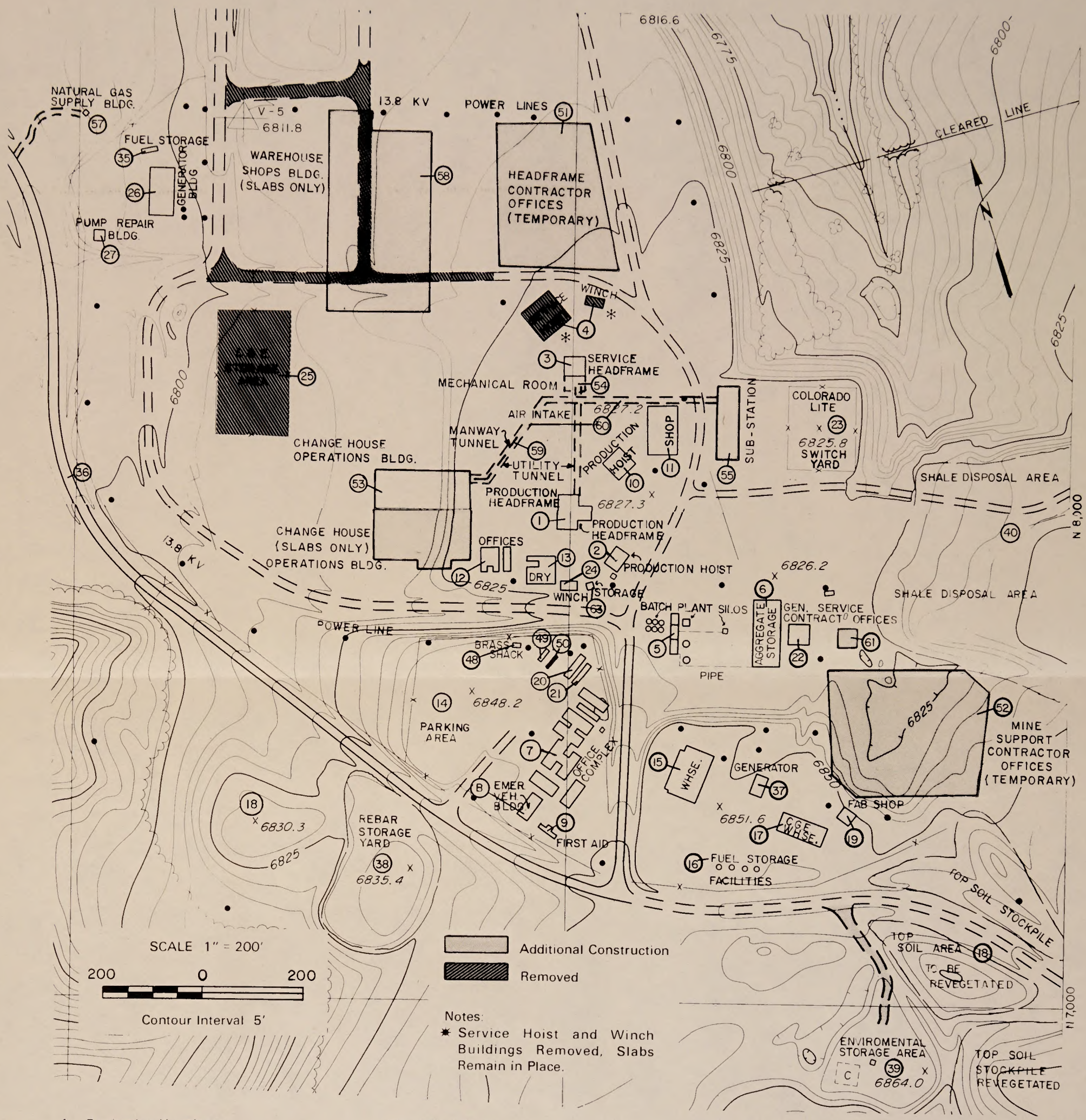
The key to the facilities' numbers is given on Table 4-1.

A near-Tract facilities inventory format was initiated in last year's report; it is further detailed on Table 4-2 to show all facilities completed on-Tract in 1982. An inventory of disturbed acreage is given in Chapter 6 and hazardous materials in Chapter 7.

Aerial views of the Tract are presented on the Frontispiece and on Figures 4-6 to 4-8. The Production and Service Shafts dominate the aboveground development with the former the taller structure.

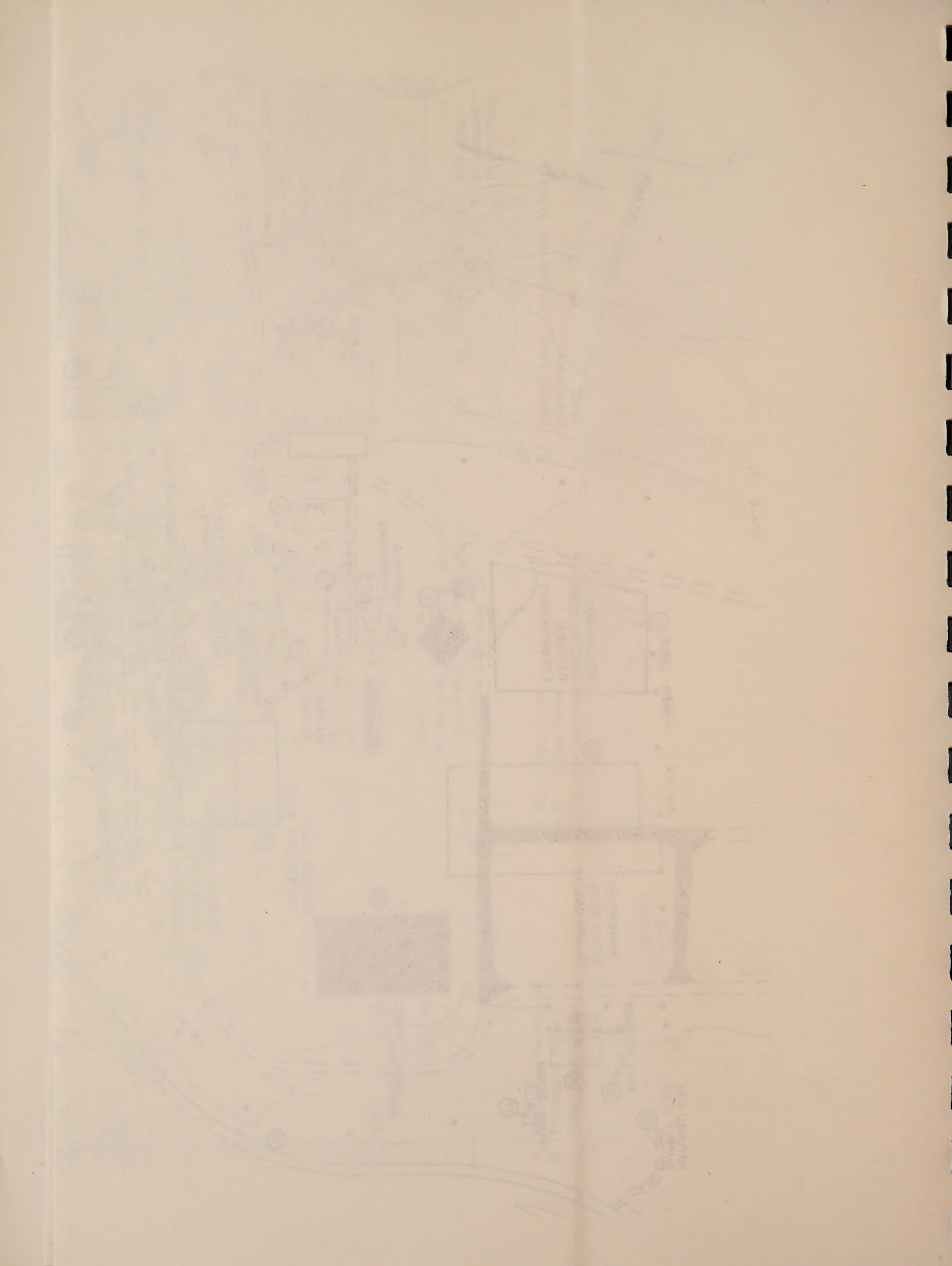
### 4.1.2 Production Shaft Headframe

Construction of the 29-foot diameter Production Shaft was begun in February, 1978 when it was "collared in" to approximately 70-foot by depth conventional excavation methods. The 313 foot headframe was "slipformed" in just 26 days during September and early October, 1978. Slipforming is a method of continuous construction in which the form is slipped or jacked-up as the concrete is poured in place. Rebar is placed ahead of the advancing form. Steel beams and floors were installed and collar floors completed; the roof and lower power floor beams were then set. The temporary sinking and galloway hoists were installed in 1978. Both are housed in metal buildings which were erected near the shaft. The Production Shaft will serve as the main "mined-rock" hoisting facility during commercial operation.




1. Production Headframe
2. Production Hoist
3. Service Headframe
4. Service Hoist and Winch
5. Cement Batch Plant
6. Cement Batch Plant Aggregate Storage
7. (H Lazy H) Office Complex (4 trailers)
8. Emergency Vehicle Building
9. First Aid Trailer
10. Production Hoist
11. Shop
12. Offices
13. Dry
14. Parking Area
15. Warehouse
16. Fuel Storage Facilities
17. Canadian General Electric Warehouse
18. Topsoil Storage Area
19. Fabrication Shop
20. Office Trailer
21. Office Trailer
22. General Service Contract Offices
23. Colorado Ute Switchyard
24. Winch
25. Canadian General Electric Storage Area
26. Generator Building
27. Pump Repair Building
35. Fuel Storage
36. Paved Main Access Road
37. Generator
38. Rebar Storage Yard
39. Environmental Storage Building
40. Shale Disposal Area
48. Brass Shack
49. Hydrology/Air Laboratory
50. Soils Lab
51. Headframe Contractor Offices (temporary)
52. Main Support Contractors Offices (temporary)
53. Changehouse/Operations Building (slabs only)
54. Mechanical Room - Service Shaft
55. Main Power Substation
57. Natural Gas Supply Building
58. Warehouse/Maintenance Shop (slabs only)
59. Manway Tunnels from Changehouse to Service and Production Shafts
60. Utility Tunnels from Substation to Service/Production Shafts and Changehouse
61. General Service Contractors Office
63. Storage Building

Figure 4-2
Topographic map showing facilities near the mine support area



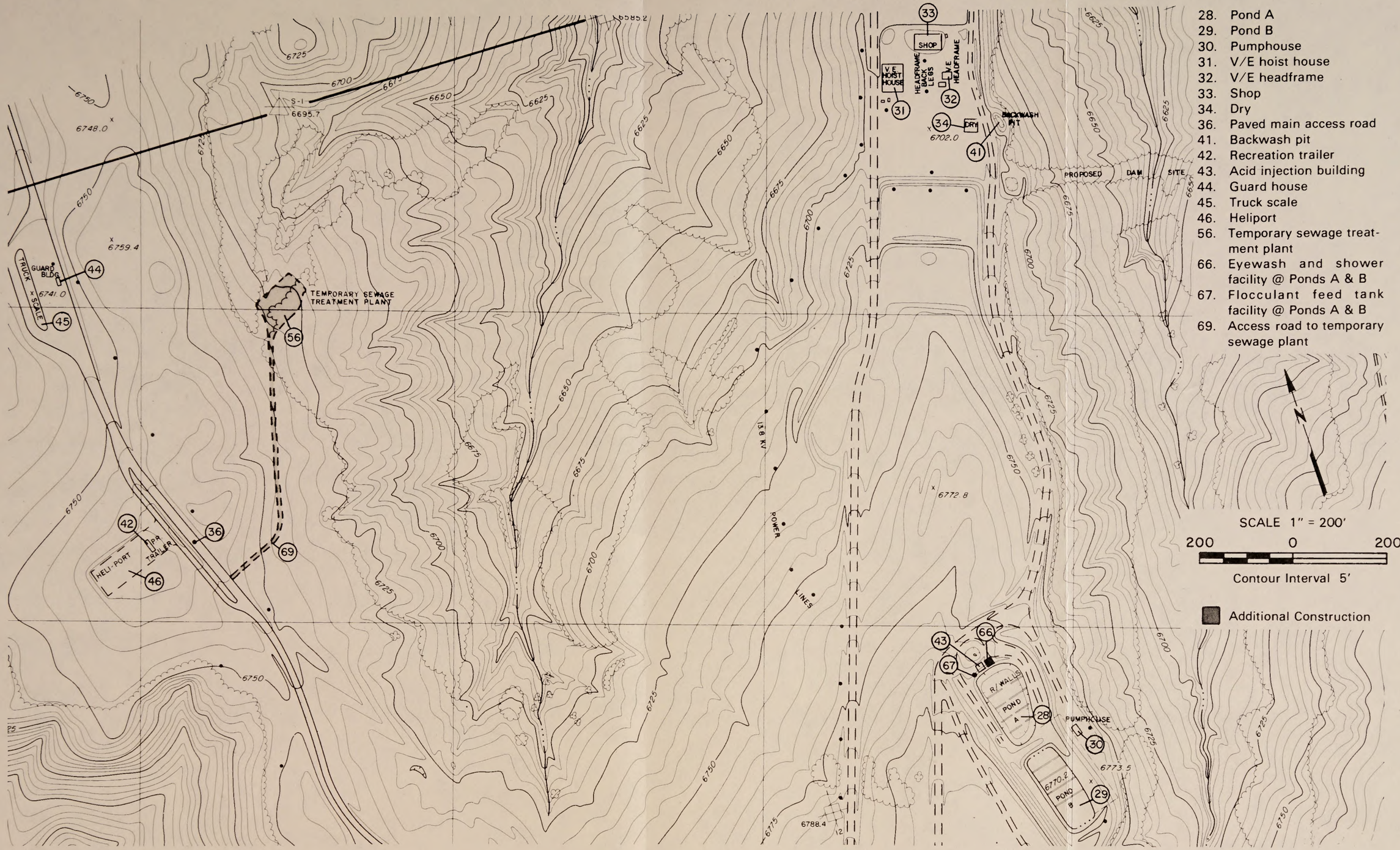



Figure 4-3
Topographic map showing facilities near the V/E shaft and Ponds A and B

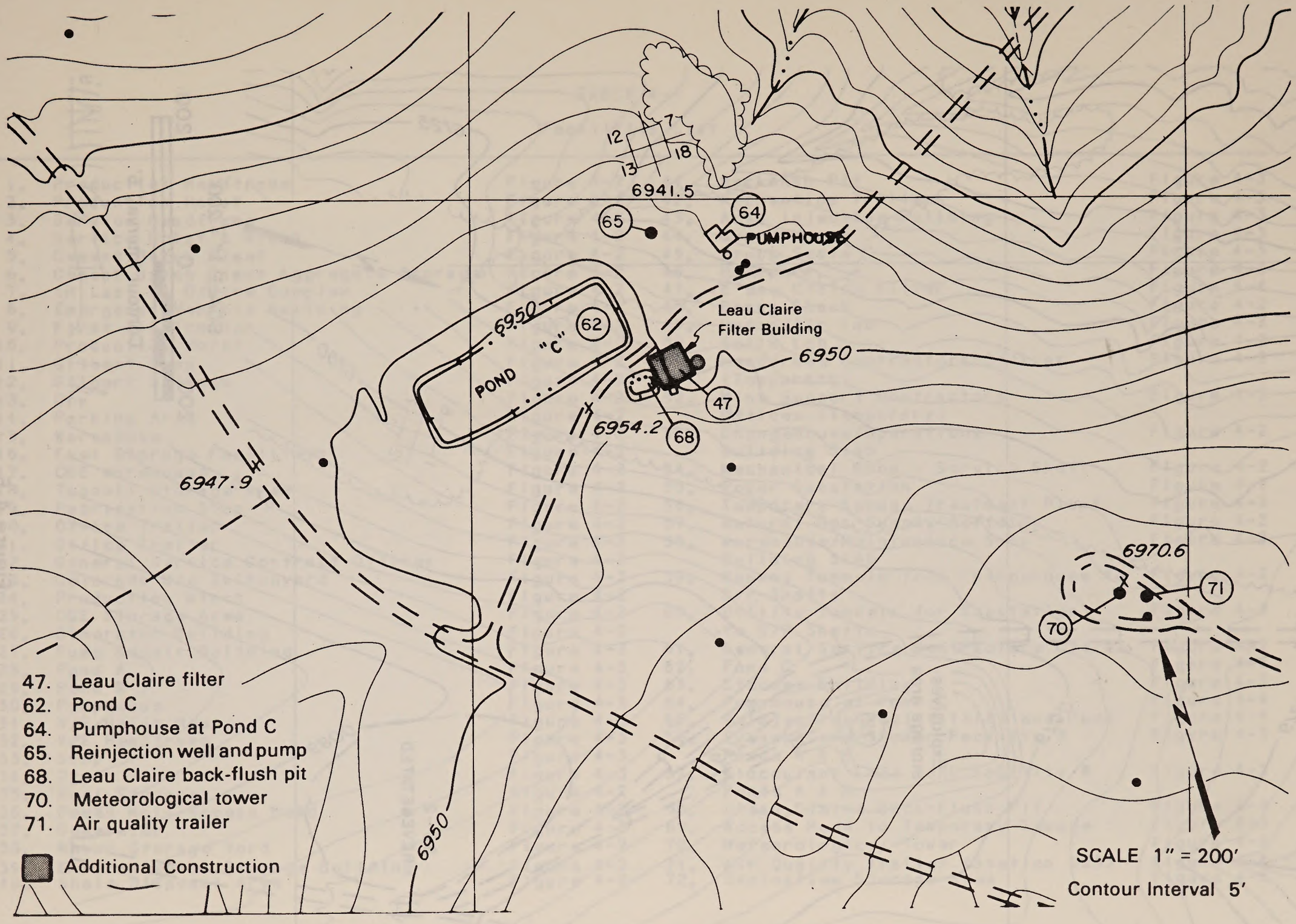



Figure 4-4
Topographic map showing facilities near the Pond C area

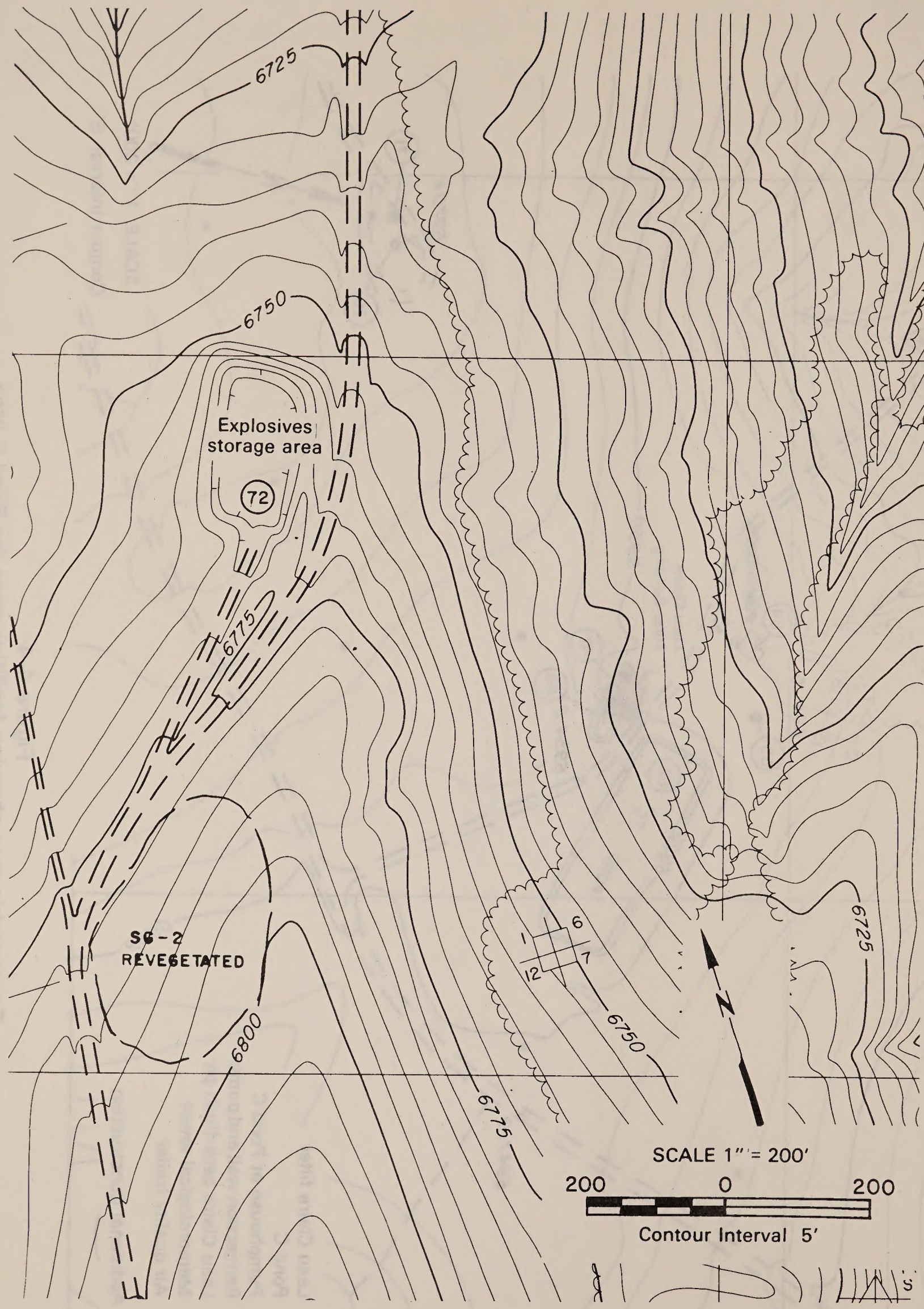



Figure 4-5
Topographic map showing facilities near the explosives area

TABLE 4-1

Facilities List

| | | | | | |
|---|---|---|---|---|---|
| 1. | Production Headframe | Figure 4-2 | 41. | Backwash Pit | Figure 4-3 |
| 2. | Production Hoist | Figure 4-2 | 42. | Recreation Trailers | Figure 4-3 |
| 3. | Service Headframe | Figure 4-2 | 43. | Acid Injection Building | Figure 4-3 |
| 4. | Service Hoist & Winch | Figure 4-2 | 44. | Guard House | Figure 4-3 |
| 5. | Cement Batch Plant | Figure 4-2 | 45. | Truck Scale | Figure 4-3 |
| 6. | Cement Batch Plant Aggregate Storage | Figure 4-2 | 46. | Heliport | Figure 4-3 |
| 7. | (H Lazy H) Office Complex | Figure 4-2 | 47. | L'eau Claire Filter | Figure 4-4 |
| 8. | Emergency Vehicle Building | Figure 4-2 | 48. | Brass Shack | Figure 4-2 |
| 9. | First Aid Trailer | Figure 4-2 | 49. | Hydro/Air Lab | Figure 4-2 |
| 10. | Production Hoist | Figure 4-2 | 50. | Soils Lab | Figure 4-2 |
| 11. | Gilbert Shop | Figure 4-2 | 51. | Headframe Contractors Offices (Temporary) | Figure 4-2 |
| 12. | Gilbert Offices | Figure 4-2 | | | |
| 13. | Dry | Figure 4-2 | 52. | Mine Support Contractors Offices (Temporary) | Figure 4-2 |
| 14. | Parking Area | Figure 4-2 | | | |
| 15. | Warehouse | Figure 4-2 | 53. | Changehouse/Operations Building Slab | Figure 4-2 |
| 16. | Fuel Storage Facilities | Figure 4-2 | | | |
| 17. | CGE Warehouse | Figure 4-2 | 54. | Mechanical Room - Service Shaft | Figure 4-2 |
| 18. | Topsoil Storage Area | Figure 4-2 | 55. | Power Substation | Figure 4-2 |
| 19. | Fabrication Shop | Figure 4-2 | 56. | Temporary Sewage Treatment Plant | Figure 4-3 |
| 20. | Office Trailer | Figure 4-2 | 57. | Natural Gas Supply Building | Figure 4-2 |
| 21. | Office Trailer | Figure 4-2 | 58. | Warehouse/Maintenance Shop Building Slab | Figure 4-2 |
| 22. | General Service Contract Offices | Figure 4-2 | | | |
| 23. | Colorado Ute Switchyard | Figure 4-2 | 59. | Manway Tunnels from Changehouse to S/P Shafts | Figure 4-2 |
| 24. | Production Winch | Figure 4-2 | | | |
| 25. | CGE Storage Area | Figure 4-2 | 60. | Utility Tunnels for Substation to S/P Shafts | Figure 4-2 |
| 26. | Generator Building | Figure 4-2 | | | |
| 27. | Pump Repair Building | Figure 4-2 | 61. | General Service Contractors Office | Figure 4-2 |
| 28. | Pond A | Figure 4-3 | 62. | Pond C | Figure 4-4 |
| 29. | Pond B | Figure 4-3 | 63. | Storage Building | Figure 4-2 |
| 30. | Pumphouse | Figure 4-3 | 64. | Pumphouse at Pond C | Figure 4-4 |
| 31. | V/E Hoist House | Figure 4-3 | 65. | Reinjection Well (11X18) and Pump | Figure 4-4 |
| 32. | V/E Headframe | Figure 4-3 | 66. | Eyewash and Shower Facility @ Ponds A & B | Figure 4-3 |
| 33. | Shop | Figure 4-3 | | | |
| 34. | Dry | Figure 4-3 | 67. | Flocculant Feed Tank Facility @ Ponds A & B | Figure 4-3 |
| 35. | Fuel Storage | Figure 4-2 | | | |
| 36. | Paved Main Access Road | Figure 4-2 | 68. | L'eau Claire Back-Flush Pit | Figure 4-4 |
| 37. | Generator | Figure 4-2 | 69. | Access Road to Temporary Sewage | Figure 4-3 |
| 38. | Rebar Storage Yard | Figure 4-2 | 70. | Meteorological Tower | Figure 4-4 |
| 39. | Environmental Storage Building | Figure 4-2 | 71. | Air Quality Trailer (Station 023) | Figure 4-4 |
| 40. | Shale Disposal Area | Figure 4-2 | 72. | Explosives Storage Area | Figure 4-5 |

TABLE 4-2

On-Tract Facilities Added/Removed In 1981

| Facility Class | Facility Type | Facility No. | Description/Use | Approximate Size (ft x ft) | Colorado Coordinates*(ft) N | E | Shown on Figure | Completion Date Year | Removal Date Year |
|---|---|---|---|---|---|---|---|---|---|
| Structures | Offices | 51 | Headframe Contractors Offices (Temporary) | 280' X 240' | N185,000 | E1,234,800 | 4-2 | 1981 | |
| | | 52 | Mine Support Contractors Offices (Temporary) | 210' X 220' | N183,600 | E1,235,400 | 4-2 | 1981 | |
| | | 61 | General Service Contractors Office | 40' X 40' | N183,800 | E1,235,100 | 4-2 | | |
| | Buildings | 53 | Changehouse/Operations Building Slab | 185' X 190' | N184,400 | E1,234,000 | 4-2 | 1981 | |
| | | 54 | Mechanical Room - Service Shaft | 30' X 40' | N184,500 | E1,234,900 | 4-2 | 1981 | |
| | | 55 | Mine Power Substation | 30' X 150' | N184,300 | E1,235,100 | 4-2 | 1981 | |
| | | 56 | Temporary Sewage Treatment Plant | 70' X 220' | N187,800 | E1,233,300 | 4-3 | 1981 | |
| | | 4 | Service Hoist and Building | 70' X 70' | N184,600 | E1,234,900 | 1980 Annual Report | | 1981 |
| | | 4 | Service Hoist Winch and Building | 20' X 40' | N184,600 | E1,235,000 | " | | 1981 |
| | | 57 | Natural Gas Supply Building | 10' X 10' | N185,300 | E1,234,100 | 4-2 | 1981 | |
| | Warehouses | 58 | Warehouse/Maintenance Shop Building Slab | 200' X 360' | N185,100 | E1,234,700 | 4-2 | 1981 | |
| | Other | 59 | Manway Tunnels from Changehouse to Service Shaft | 10' X 10' | N184,600 | E1,234,800 | 4-2 | 1981 | |
| | | 60 | Utility Tunnels from Substation to Changehouse and S/P Shafts | 8' X 8' | N184,500 | E1,235,100 | 4-2 | 1981 | |

*Approximate Center

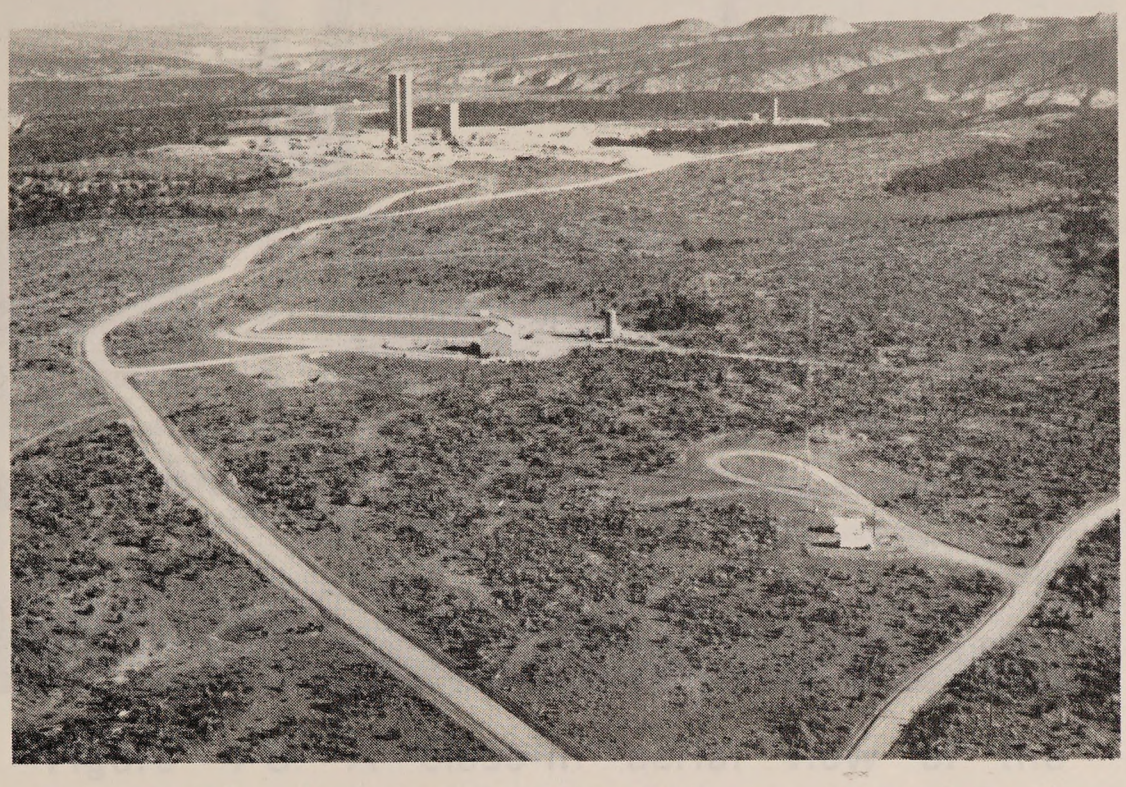


Figure 4-6. Aerial view of the C-b tract taken from the south showing air quality station AB23 and the meteorological tower in the foreground, pond C and the L'eau Claire filter in mid-picture and the shaft headframe further north. (April 1981)

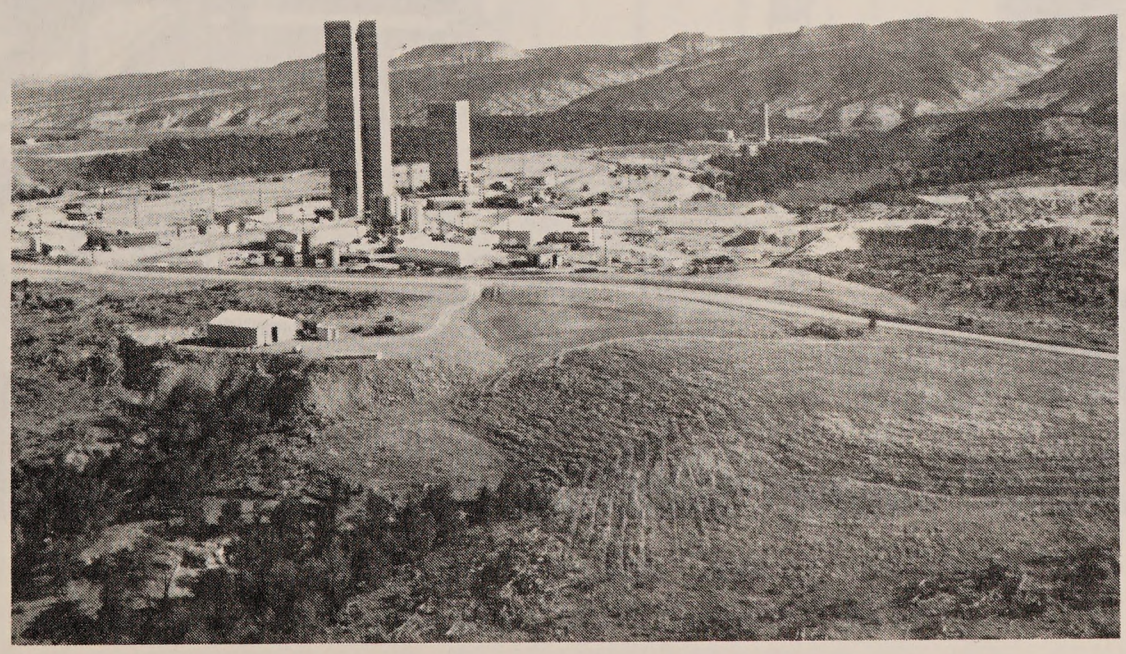


Figure 4-7. A close-in aerial view of the headframes as seen from the southwest. (April 1981)

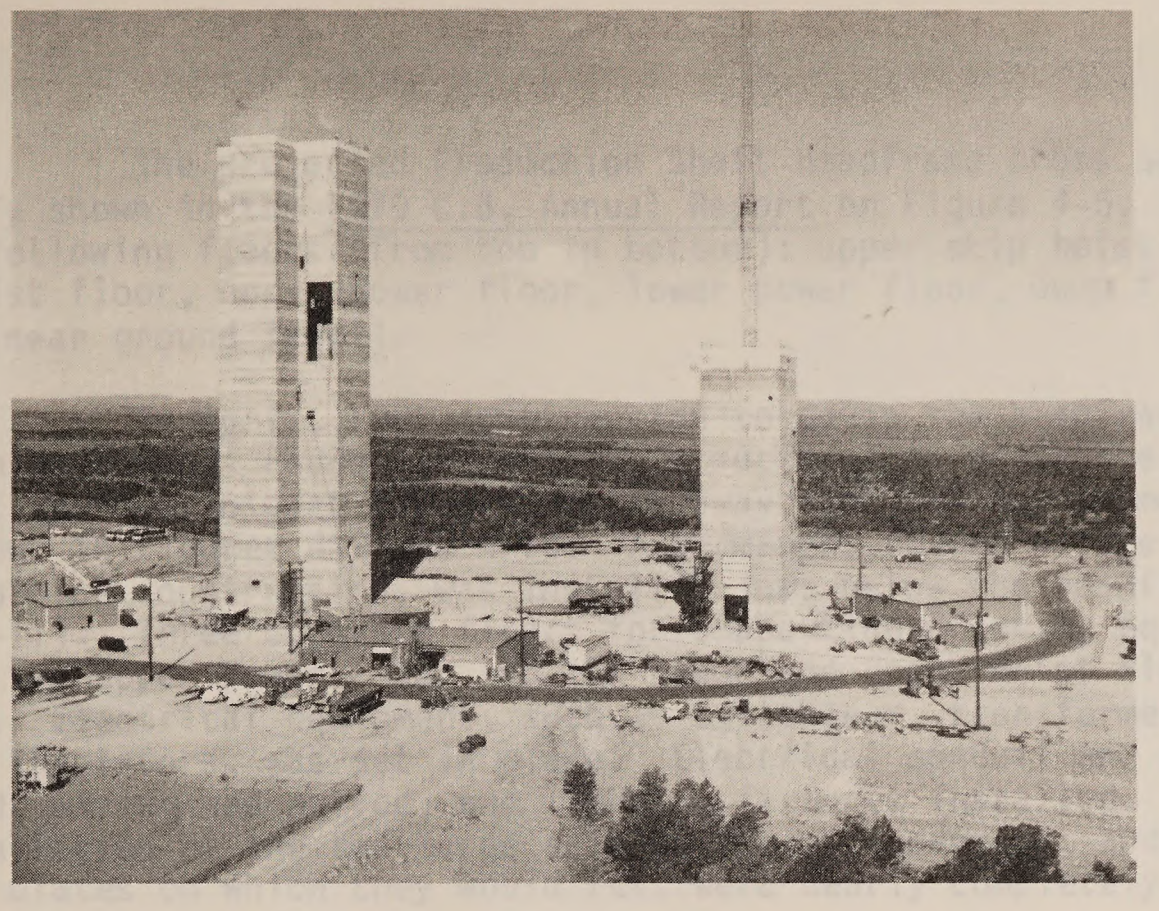


Figure 4-8. A close-in aerial view of the headframes and tract development area as seen from the east. (April 1981)

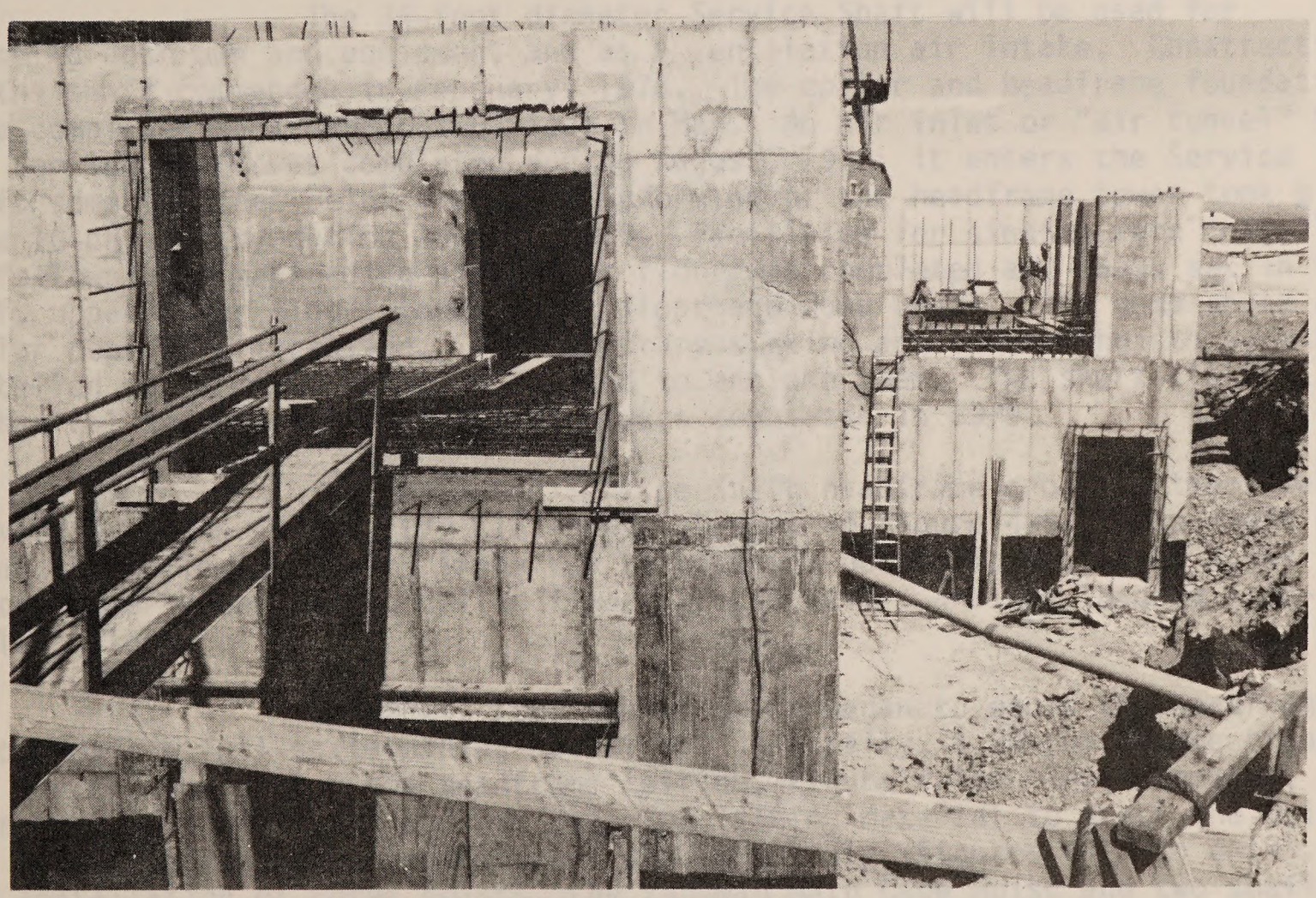


Figure 4-9. Progress on the feeder extension building at the production shaft. (June 1981)

The projected Production Shaft headframe cross sections were previously shown in the 1979 C.B. Annual Report on Figure 4-6. This shaft contains the following floors (from top to bottom): upper skip hoist floor, lower skip hoist floor, upper power floor, lower power floor, dump floor, and collar floor (near ground level).

In April, 1981 construction to equip the headframe for full-scale mining began. Feeder extensions, structures to house the two feeder conveyors that would transport mined material away from the headframe, were erected as shown in Figures 4-9 and 4-10. A permanent 60-ton bridge crane, also used in aiding construction, was installed just below the headframe ceiling (Figure 4-11). Three concrete floors for supporting hoisting equipment were erected, the Upper Power Floor and the Lower and Upper Hoist Floors (Figure 4-12). Electrical equipment, such as switchgear, transformers and speed control thyristors, was set in place. Electrical conduit and cable trays were installed, wiring was pulled, and lighting fixtures installed. Preparation for installation of the two large skip hoists got underway; and by year's end, the sole plates on which they would rest were nearly completely installed (Figure 4-13).

### 4.1.3 Service Shaft Headframe

The 34-foot diameter Service Shaft will be used for hoisting both men and equipment and as a ventilation air intake. Construction of the shaft commenced in February, 1978. The collar and headframe foundations were completed at a depth of 65 feet in May. An air inlet or "air tunnel" to the Service Shaft was completed during August, 1978; it enters the Service Shaft some 100 feet below grade. Slipforming of the headframe tower took place in a 10-day period during August, 1978. Facilities for sinking were installed as follows: the manloading and collar floor was completed and beams set in the roof, upper power floor, lower power floor and dump chute. The dump chute and collar door were installed. The temporary sinking and service hoists were then installed and a metal building erected to enclose them. The shaft-sinking mechanical and electrical facilities were completed in 1979.

The projected Service Shaft headframe cross sections were previously shown in the 1979 C.B. Annual Report on Figure 4-9. This shaft contains the following floors (from top to bottom); hoist floors, upper power floor, lower power floor, collar floor (ground level) and man loading (sub-collar) floor.

In April, 1981 construction began to equip the headframe to accommodate a full-scale mining operation. Initially, a 30-ton bridge crane was erected just below the headframe ceiling, Figure 4-14. This permanent crane became operational and was used for lifting material to erect the Hoist and Power Floors, where concrete was placed in July (Figures 4-15 to 4-17). The installation of three hoists, the 240-man Main Cage Hoist and two smaller Auxiliary Hoists, was well underway by year's end. Auxiliary Hoist #1 was 75% complete, while Auxiliary Hoist #2 was mechanically complete and was undergoing electrical hook-up. The Main Cage Hoist bearings were set and aligned, the drum and shaft installed, motor enclosures completed, and hoist accessories were aligned. Electrical equipment was set in place and installation of electrical bulk materials--conduit, cable tray, wire and light fixtures - was in

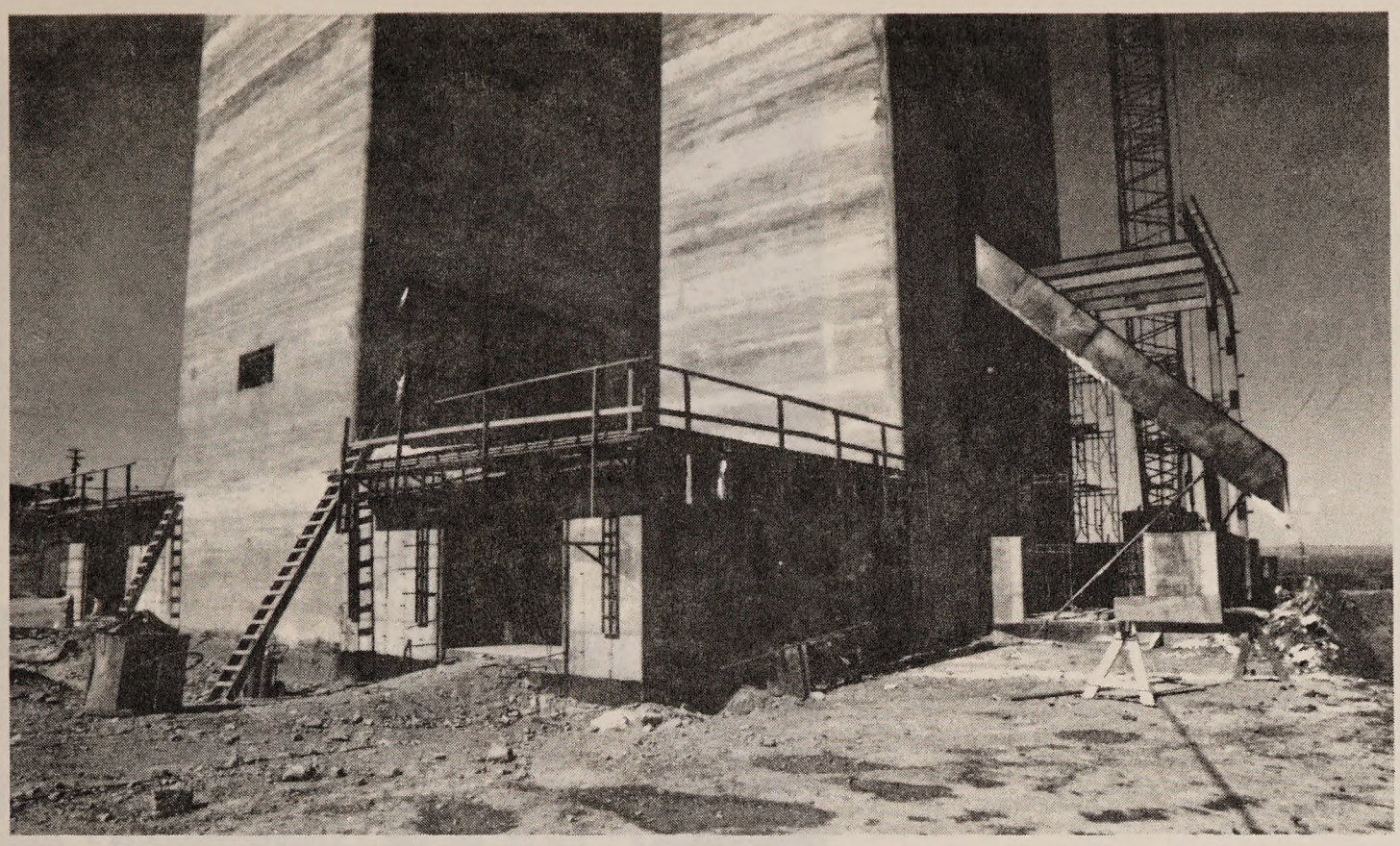


Figure 4-10. Further progress on the feeder extension at the production shaft. (July 1981)

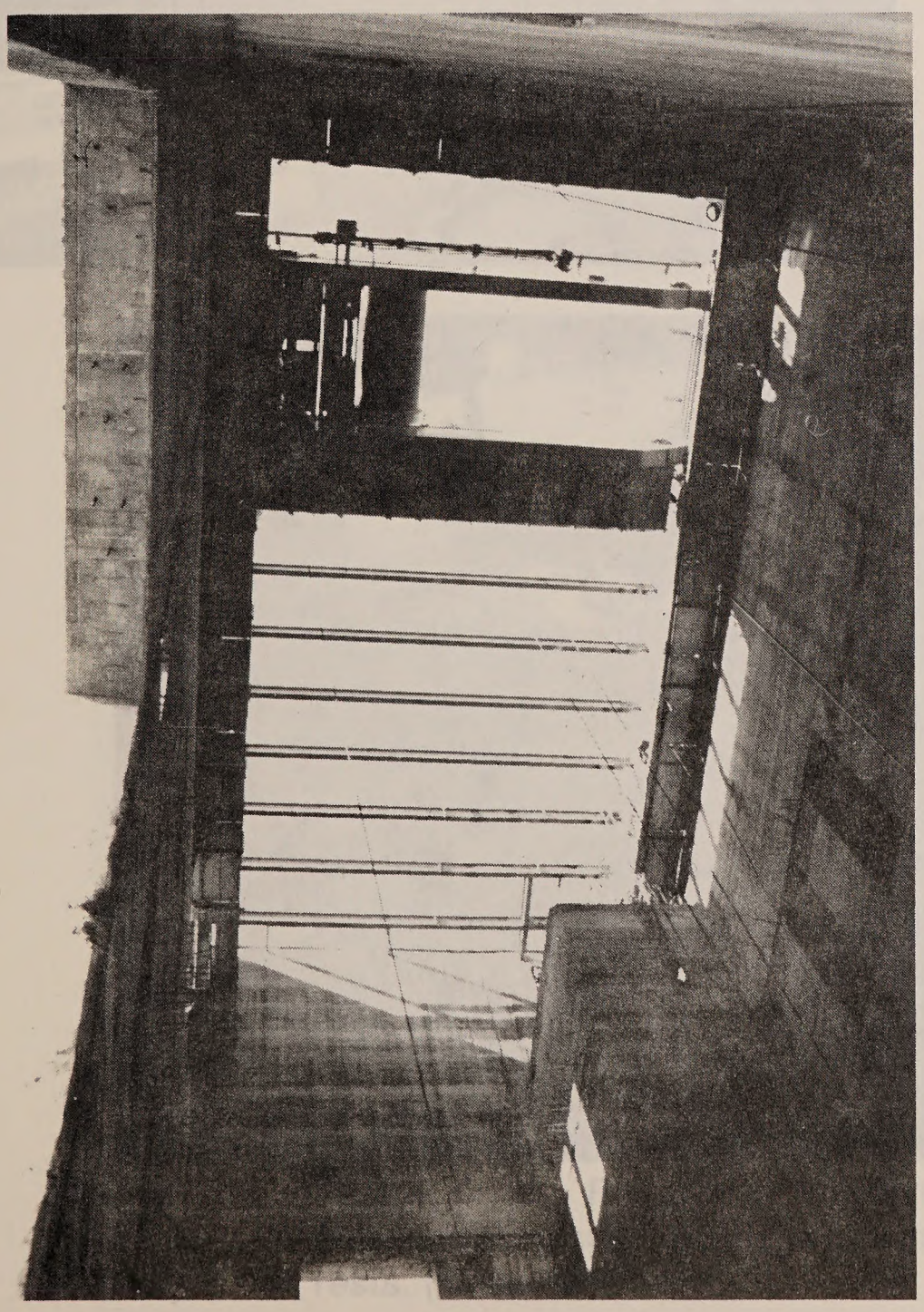
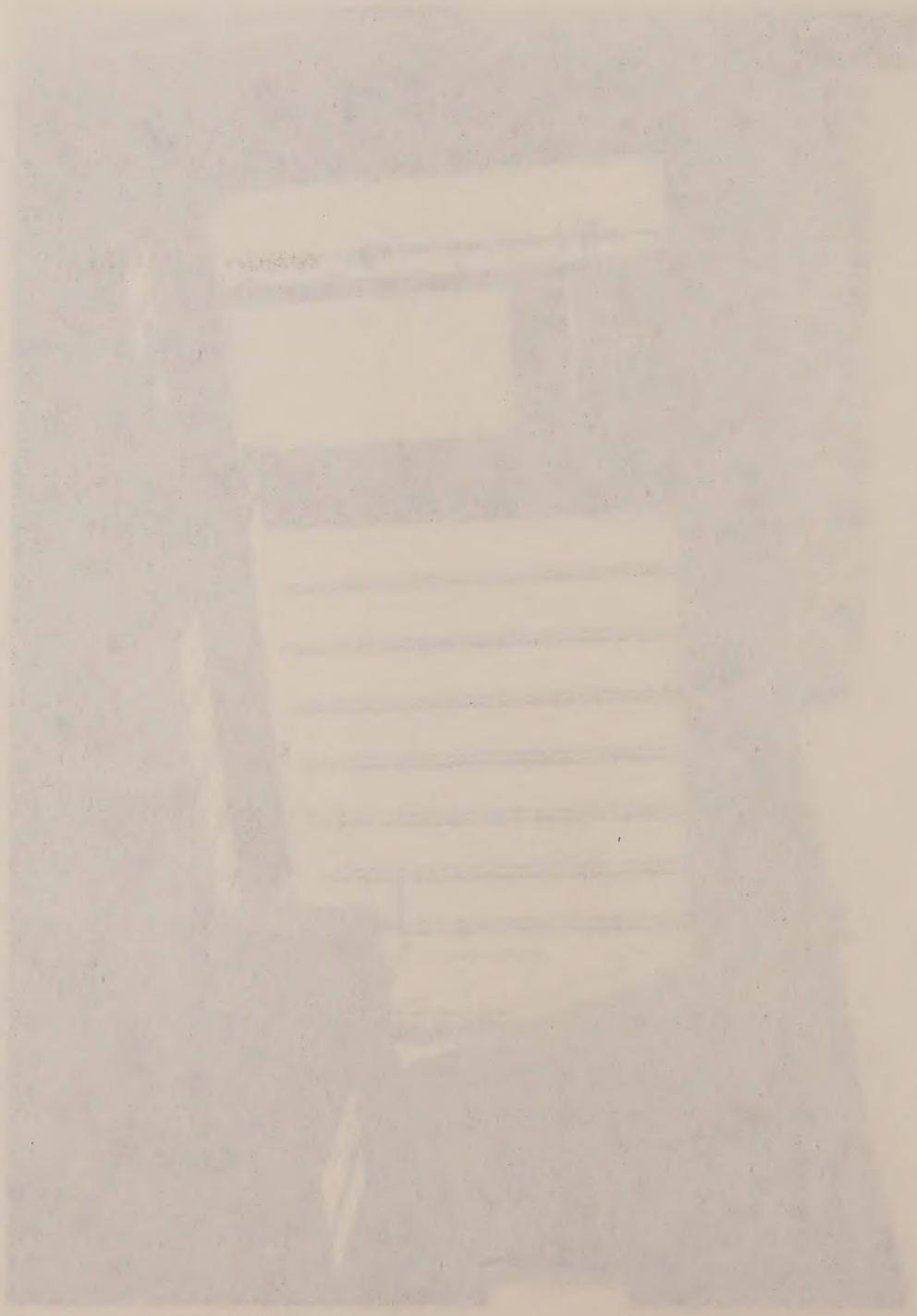


Figure 4-11. The 60-ton overhead crane in the production shaft. (July 1981)



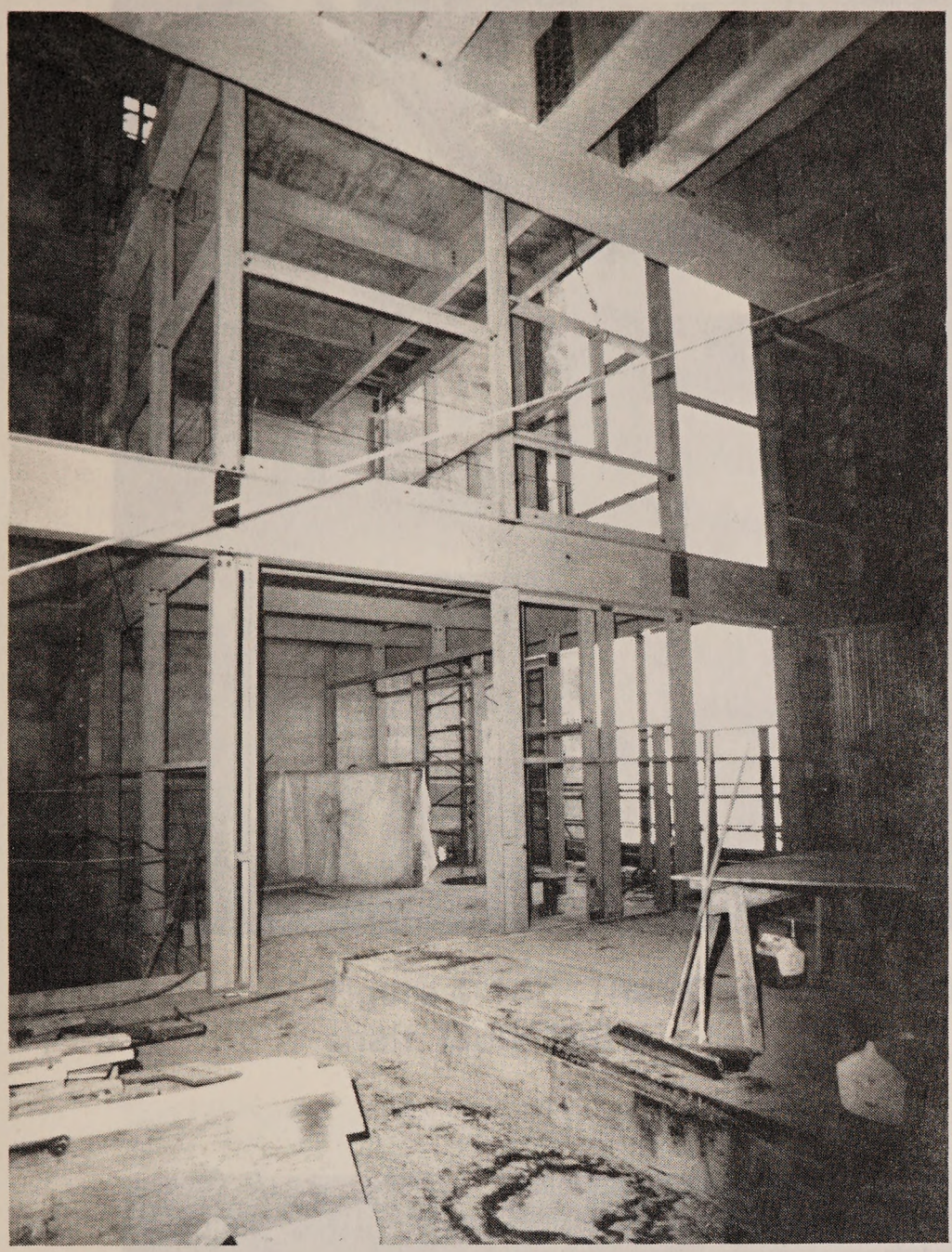


Figure 4-12. Upper and lower power floors in the production headframe. (October 1981)

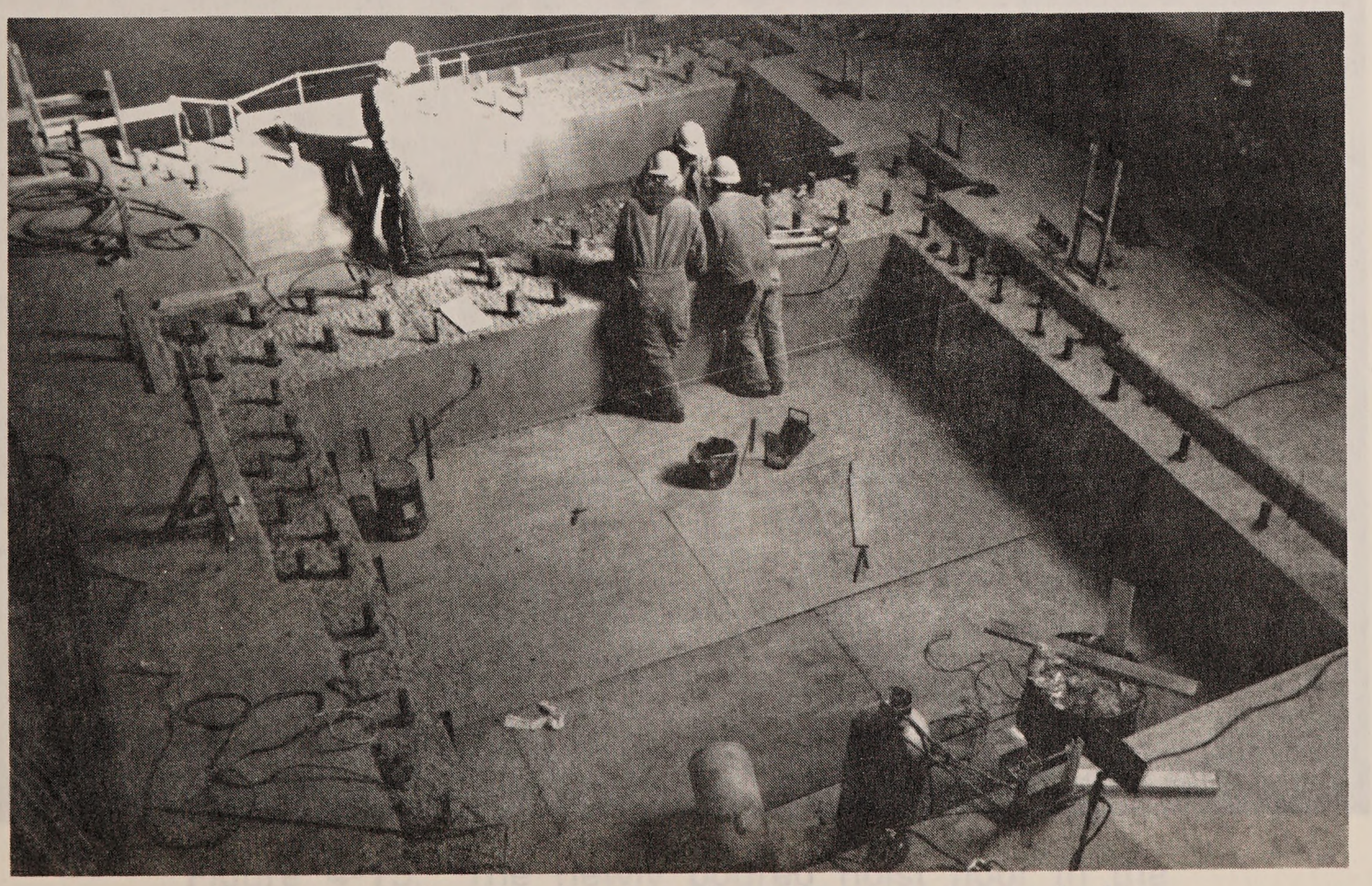


Figure 4-13. Production headframe upper hoist floor showing start of sole plate installation for hoist rests. (November 1981)

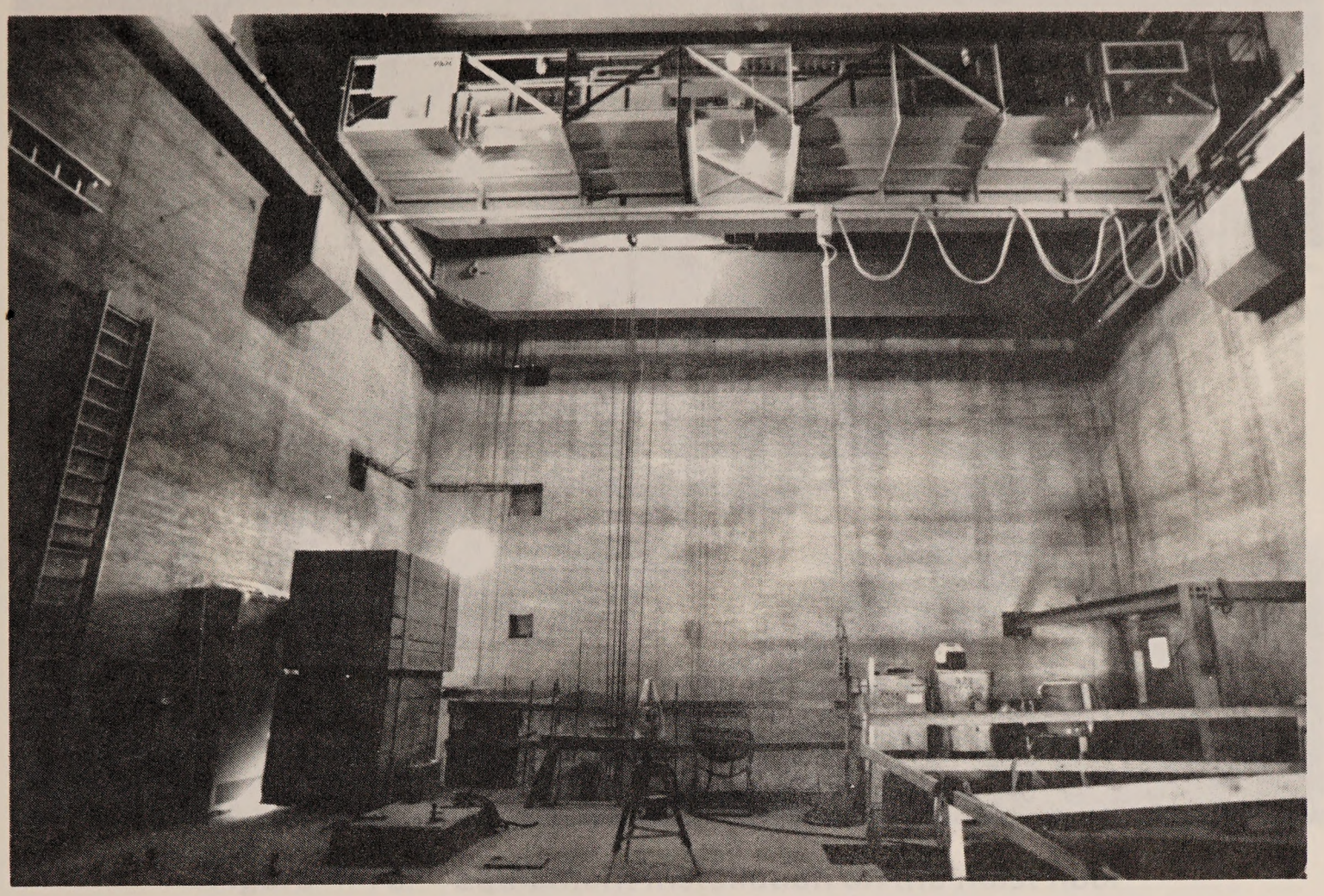


Figure 4-14. The 30-ton overhead crane in the service shaft. (July 1981)

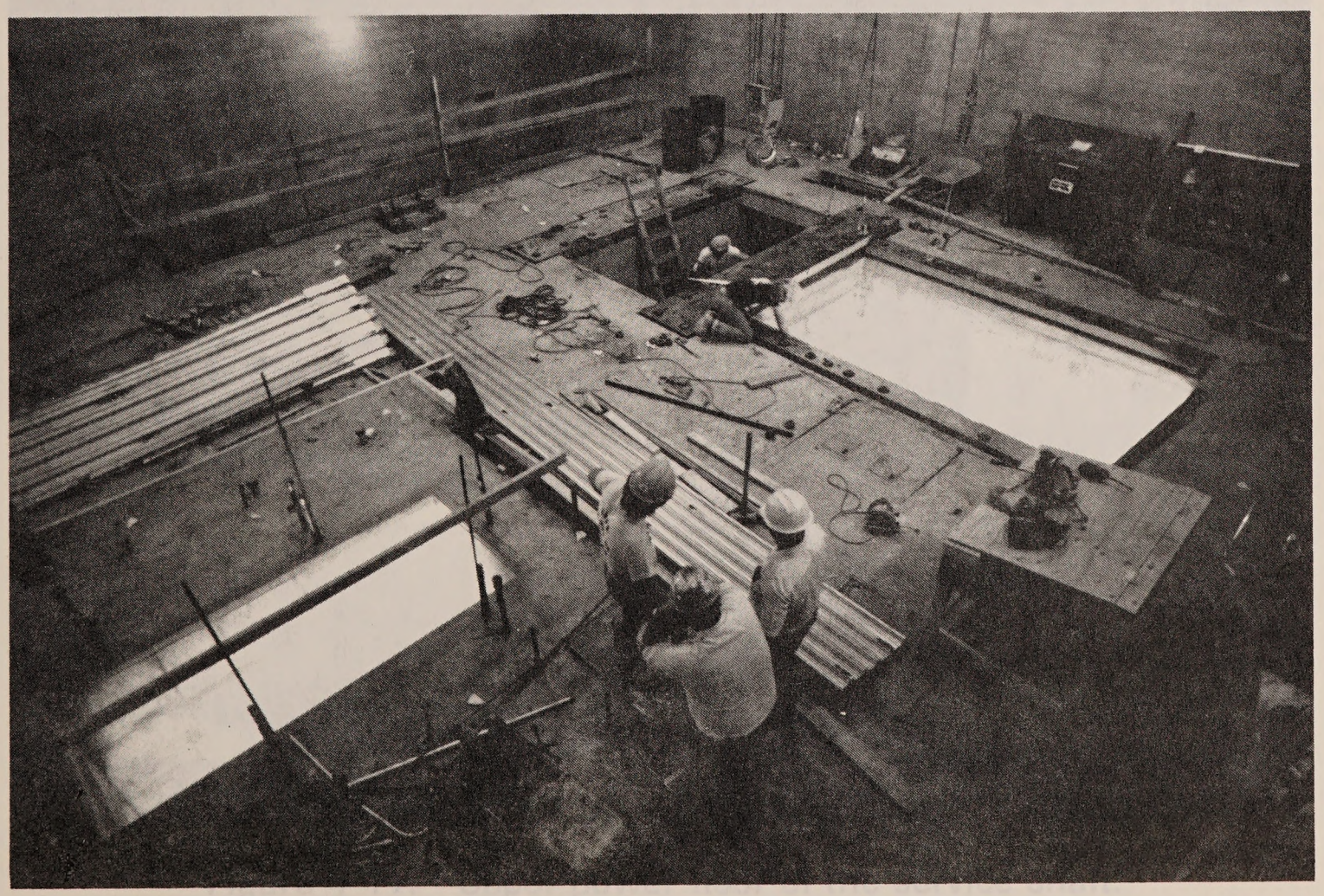
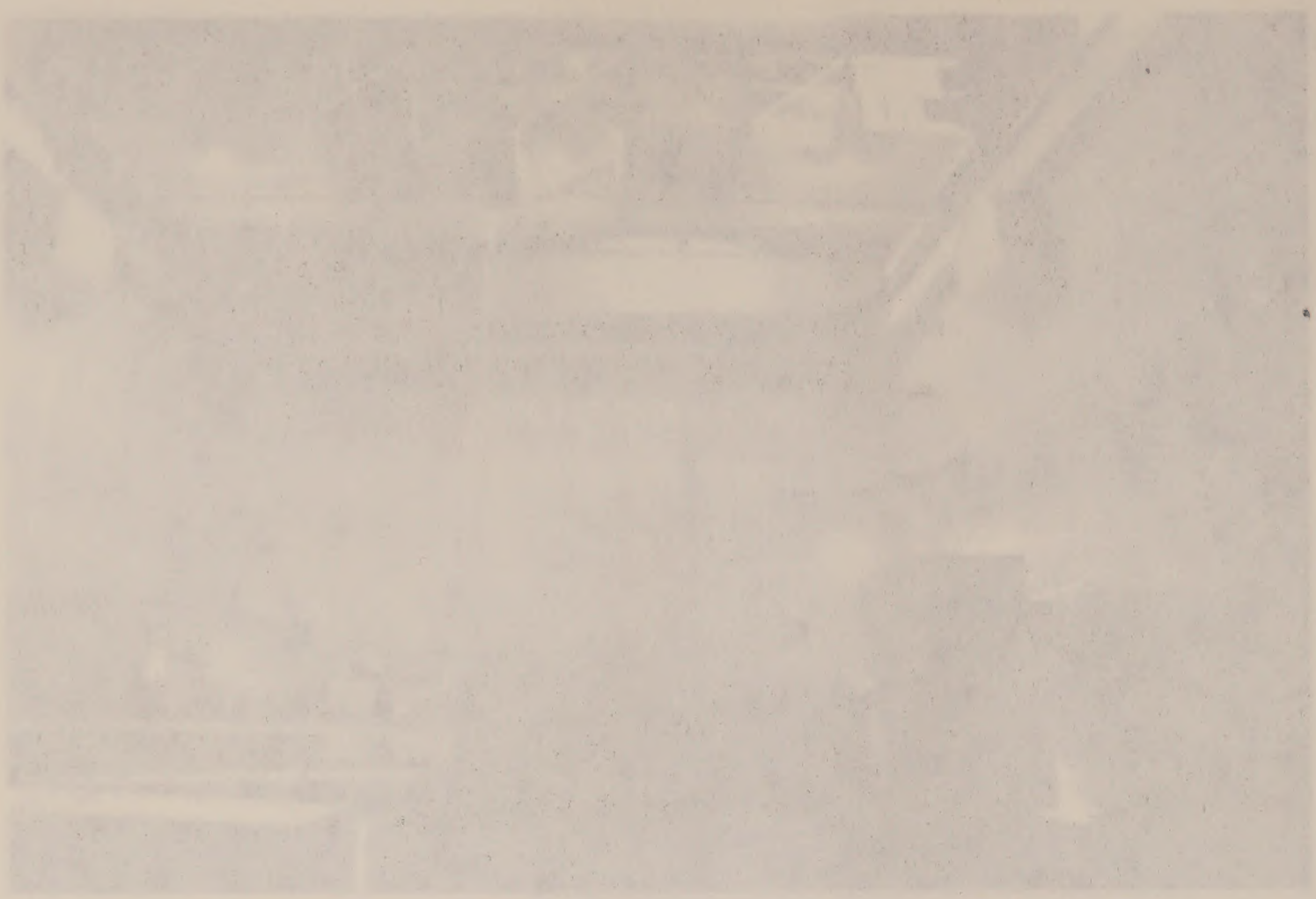


Figure 4-15. The newly poured hoist floor in the service shaft. (July 1981)



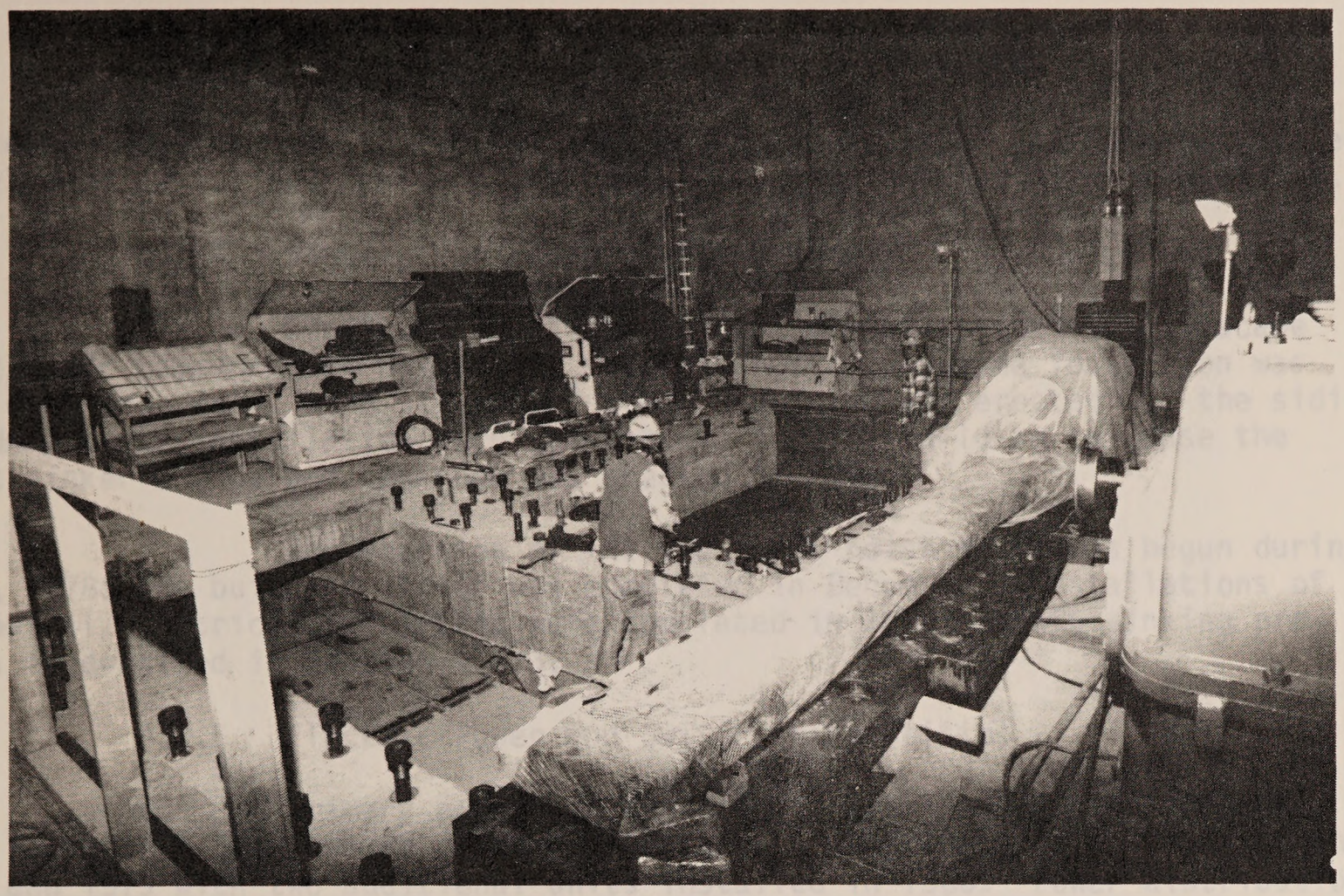


Figure 4-16. Equipment installation on the hoist floor of the service headframe (September 1981)

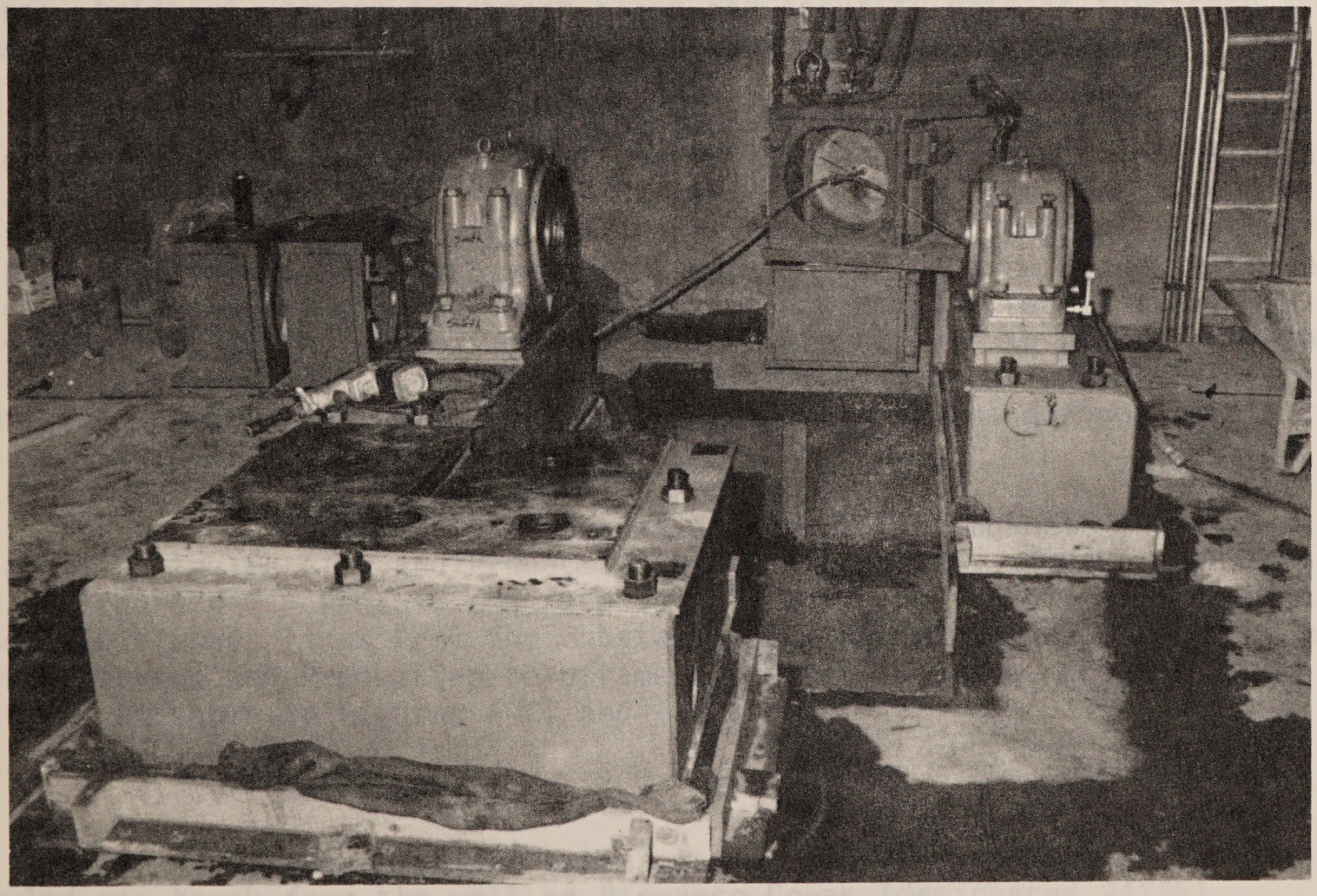


Figure 4-17. Upper power floor of the service shaft.

progress. Concrete was placed for the floors and walls of the Mechanical/Electrical Room on the south side of the headframe and the West Airlock Building.

### 4.1.4 Ventilation/Escape Shaft Headframe

Construction of the 15-foot diameter Ventilation/Escape (V/E) Shaft commenced in May, 1978; the collar and headframe foundation was completed that June. The structural steel headframe was erected and the siding and dump chute installation were completed. A metal building to house the shaft sinker's shop and dry room was erected in 1978.

Construction of the V/E Shaft hoist house was begun during July, 1978; the building itself was completed in December. Installations of mechanical/electrical facilities were completed in 1979. Shaft sinking progress is detailed in Section 4.4.3.

### 4.1.5 Electric Power and Switching Facilities

Primary power for the site is provided by nine 1000 KW, 4160 V, natural-gas-powered diesel generators. Seven units were installed in 1978 and 1979 with two additional units installed in 1980. Power distribution is by 13.8 KV overhead poleline to the shafts, batch plant, warehouse and office areas. Generators are placed on line as requirements demand with at least one unit in stand-by mode at all times. In addition, there are four 250 KW, 440 V diesel-driven generators to provide emergency power to the batch plant and office/warehouse complex. Power for environmental monitoring stations, heliport, sewage treatment plant and security gate is furnished at a loading of 7.2 KV by the White River Electric Company via rural power lines.

Site preparation for the switchyard and mine power substation was initiated in July, 1980. High-voltage equipment was installed at both areas by February, 1981. In April, 1981 erection of the Meeker-to-C.B. 13.8 KV power line got under way, and it was completed by October. Routing for this line was discussed in last year's report. A building to house switchgear and transformers for the mine power substation was constructed in 1981. By year's end, most of the electrical equipment there was set in place, and electrical cable tray installation had began. Also the line was successfully energized and tested. Figures 4-18 to 4-20 depict progress during 1981 on these facilities.

In July, 1981 excavation for utility tunnels from the Mine Substation to the Service and Production headframes began. Their location is shown on Figure 4-2. Precast concrete tunnels which would initially carry 13.8 KV and 4160 V power lines from the Substation to the Service headframe and between the Service and Production headframes were set in place, grouted, and backfilled as shown in Figures 4-21 and 4-22.

### 4.1.6 Water Wells

Water for the batch plant operations and shower facilities is hauled via truck from the well on Piceance Creek (designated 24X25). Potable water is hauled from Rifle.

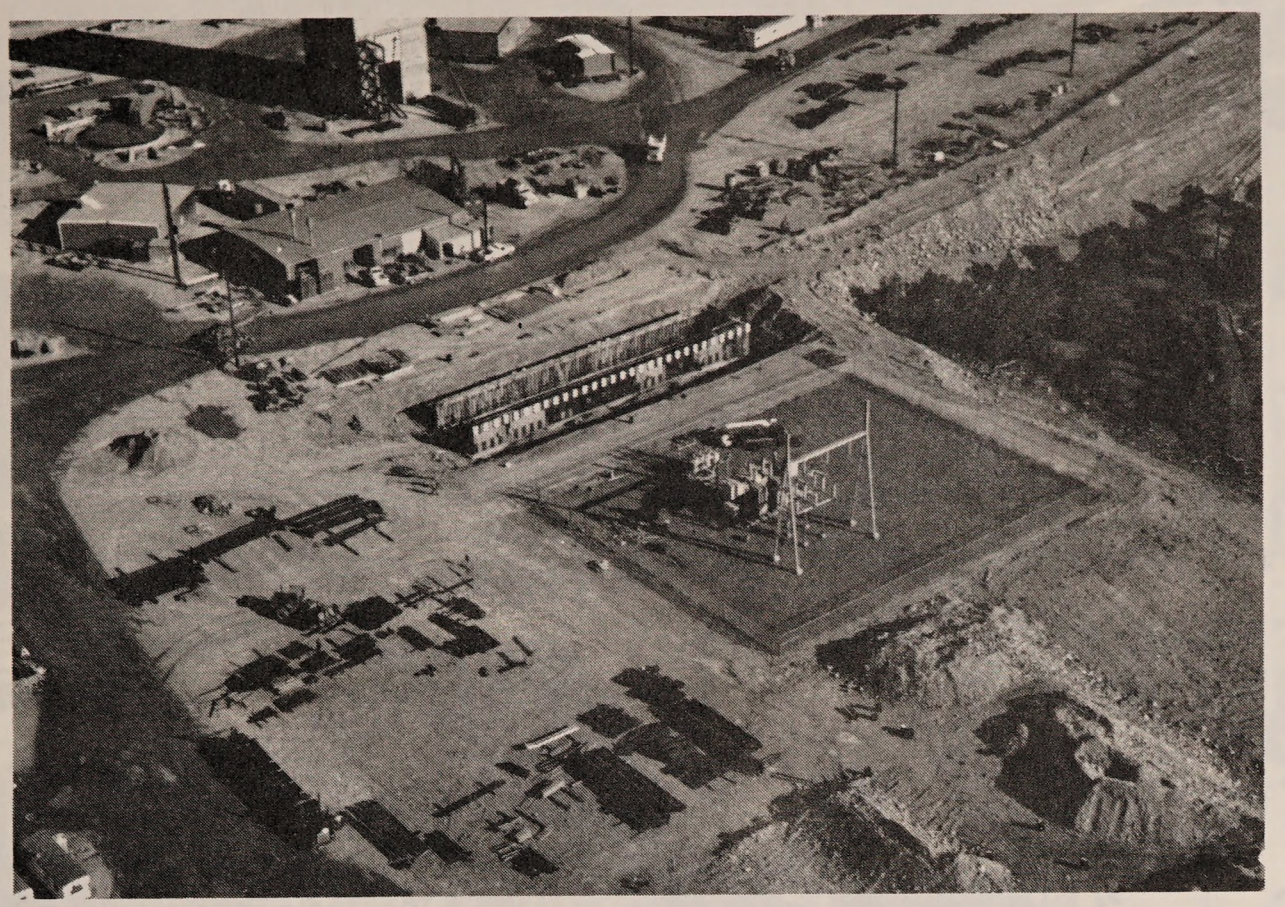


Figure 4-18. Aerial view of the switchyard and mine power substation. (May 1981)

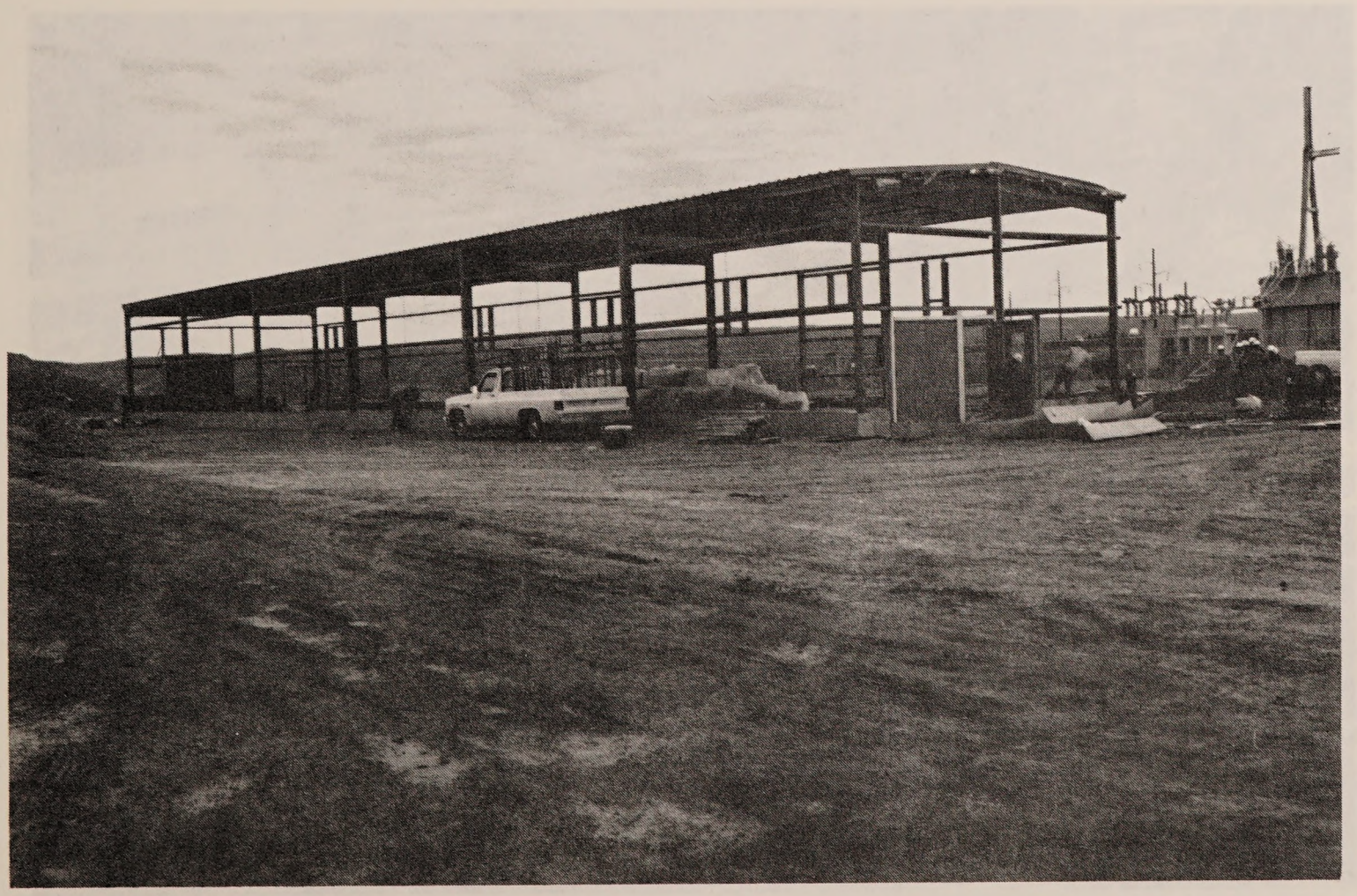
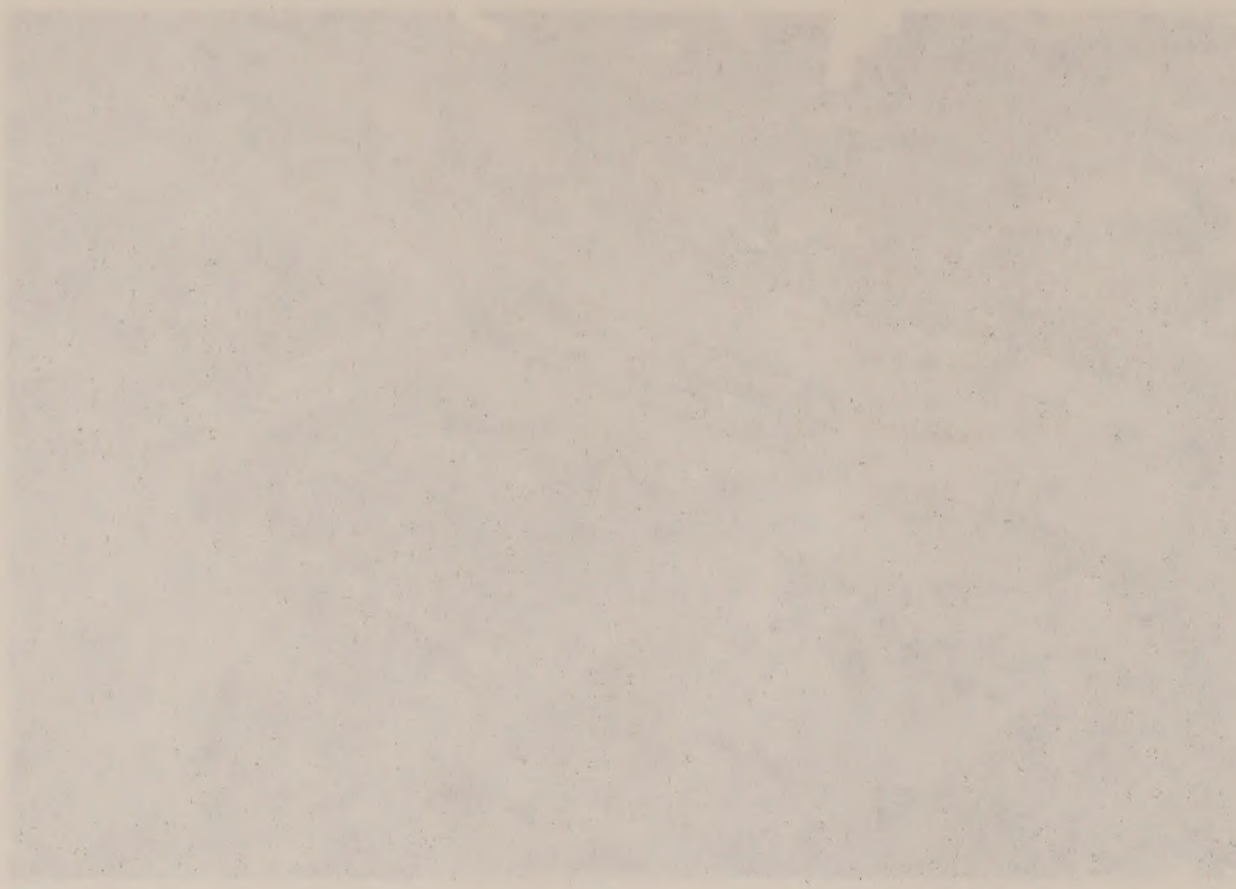


Figure 4-19. Completed foundation at the mine power substation. (September 1981)



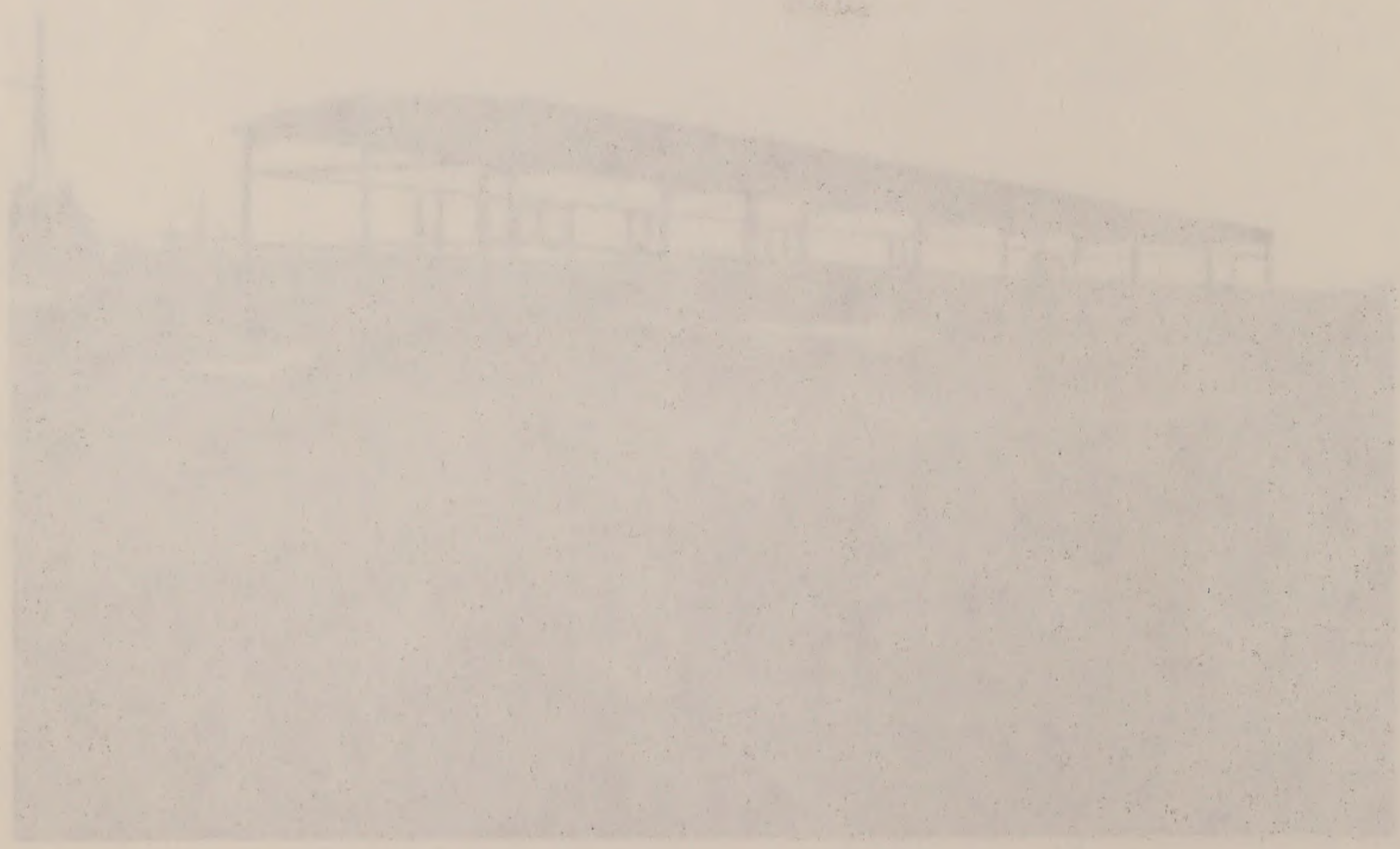


Figure 4-20. Excavation for the bus ducts from the switchyard to the power substation. (October 1981)

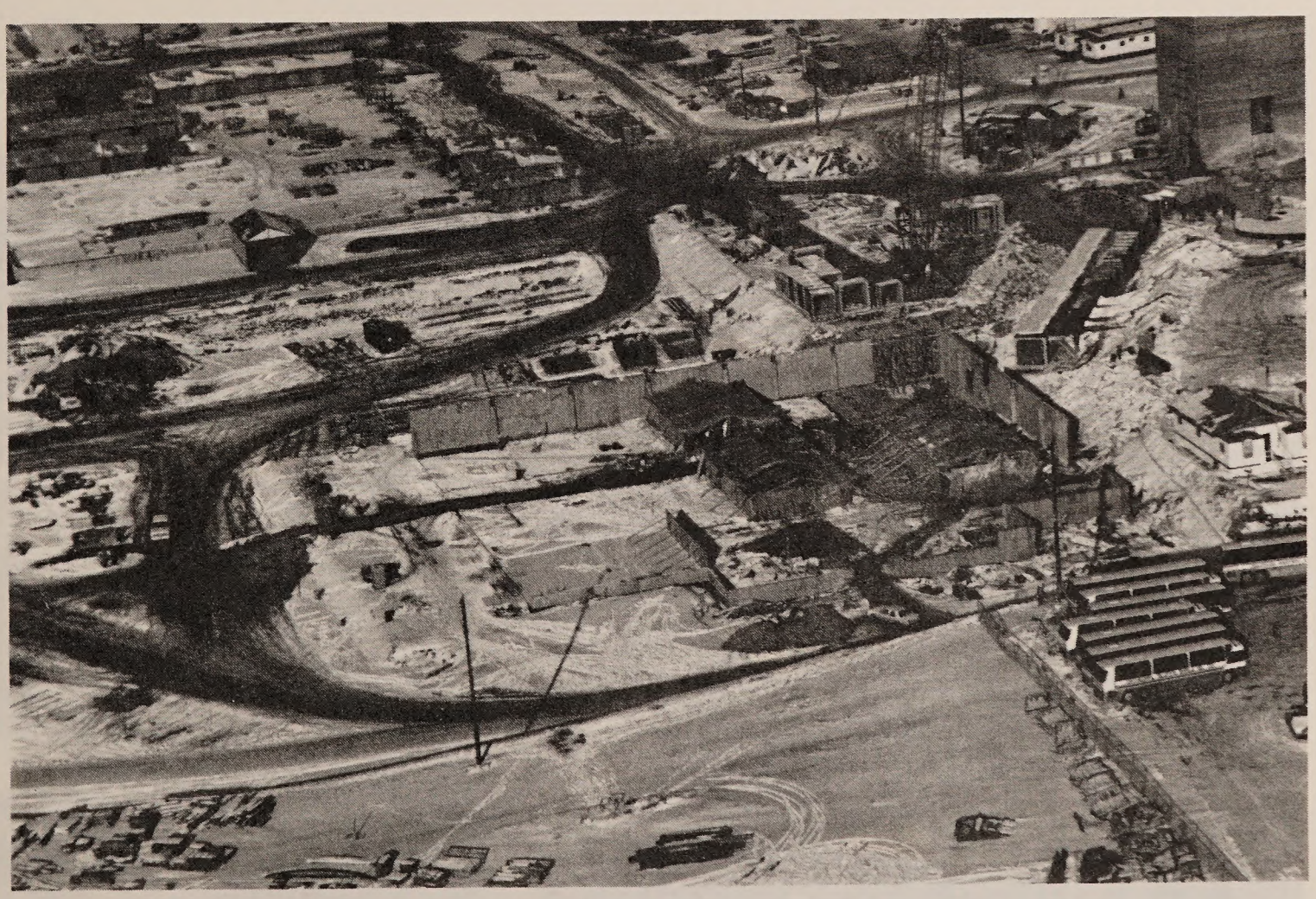


Figure 4-21. Aerial view of changehouse and tunnel construction. (November 1981)

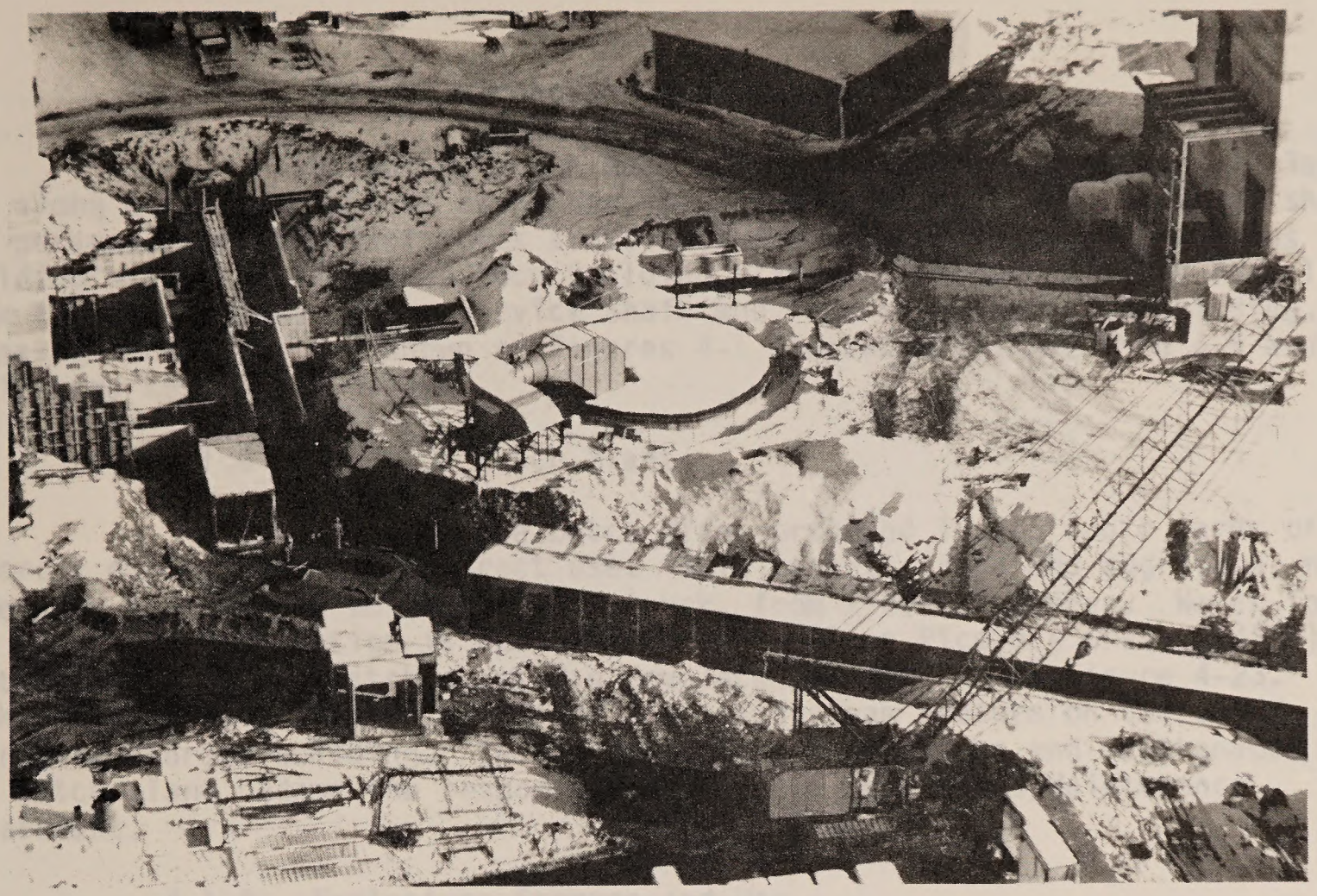


Figure 4-22. Utility tunnel from changehouse to service headframe is 85% complete. (November 1981)

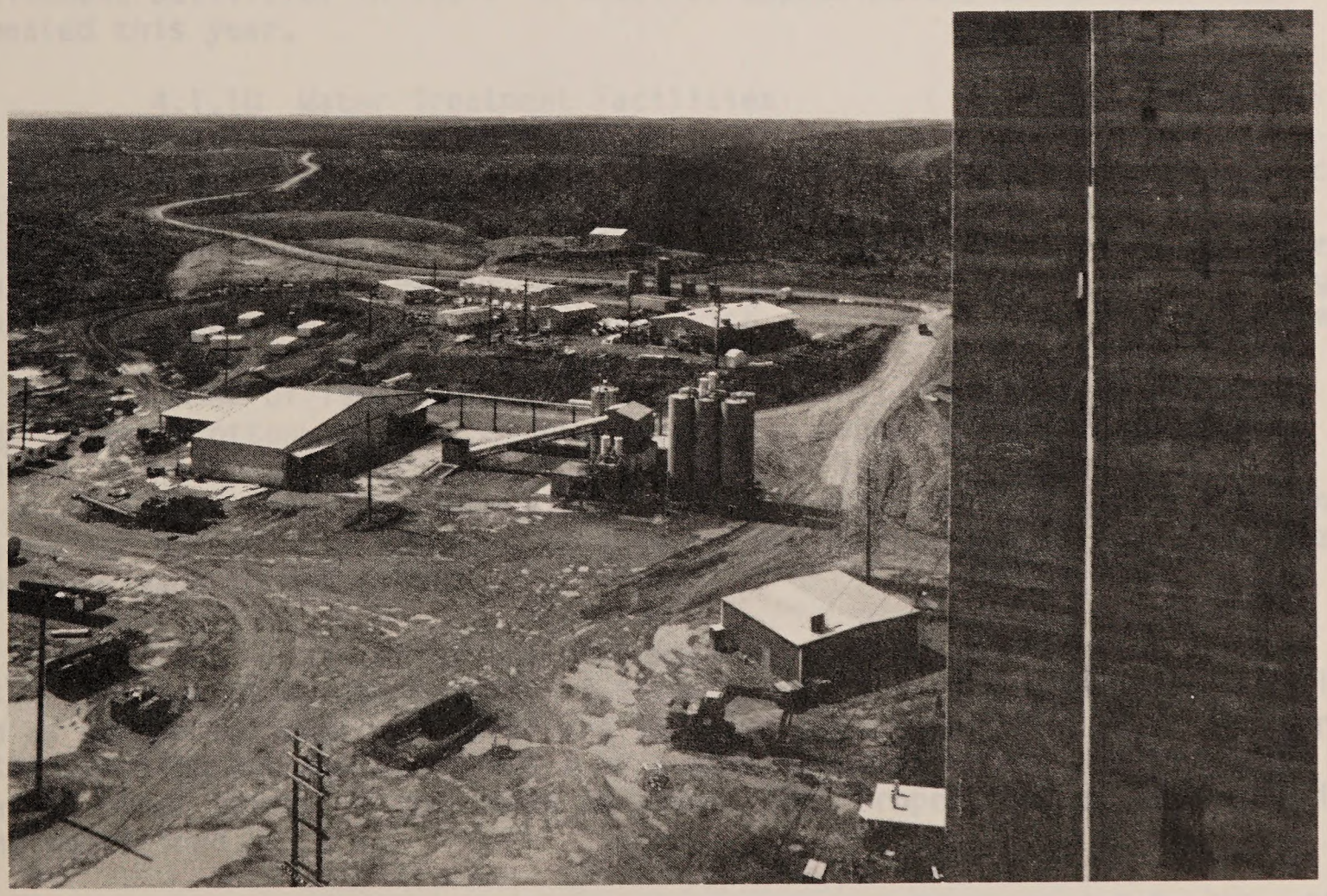
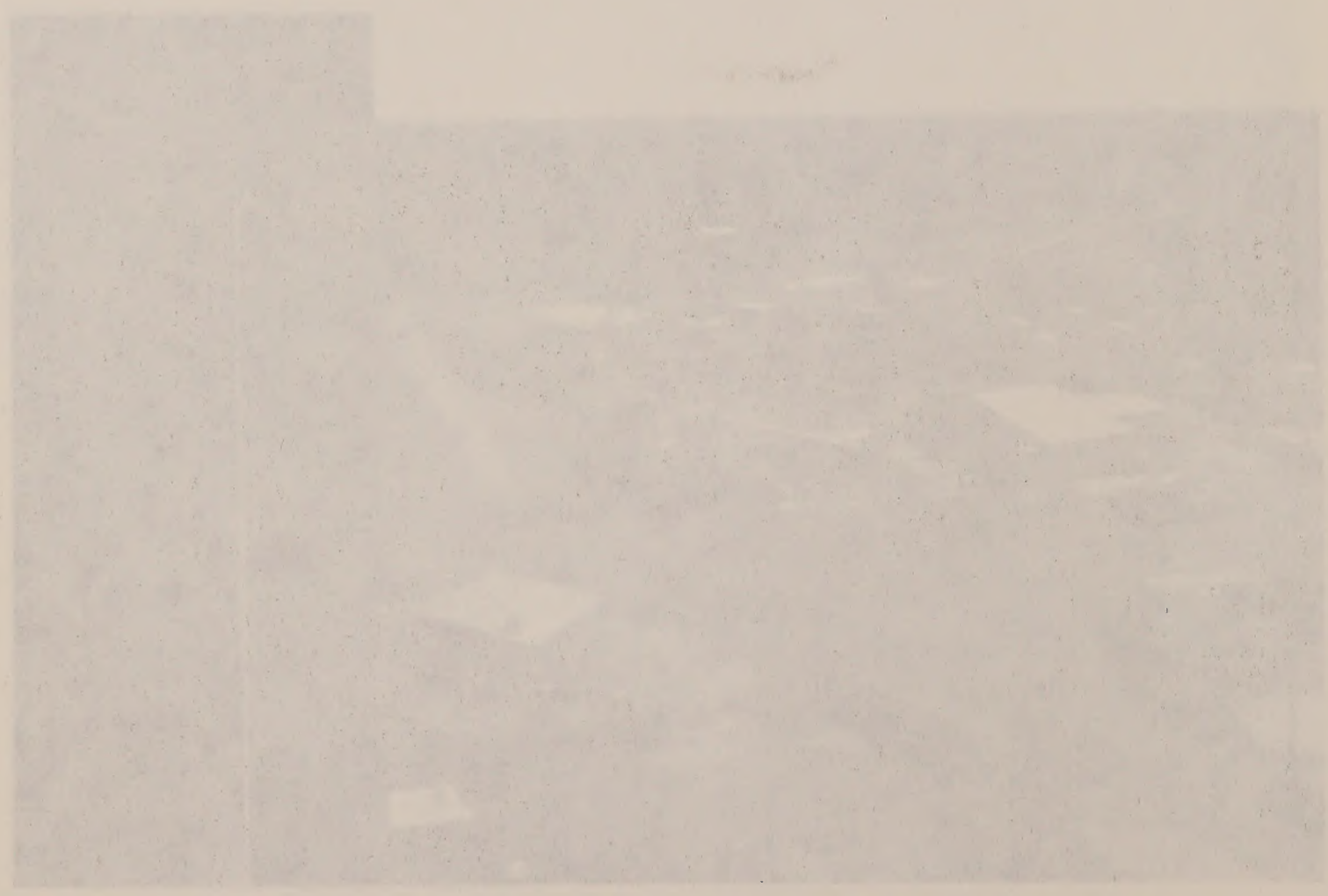


Figure 4-23. Aerial view of the cement batch plant and aggregate storage building. (May 1981)



### 4.1.7 Office, Warehouse, and Shop Facilities

Buildings which were completed in 1981 are listed in Table 4-2 along with descriptions as to use, size and location. Major office, shop and personnel-related facilities added included the Changehouse/Operations Building slab, the Warehouse/Shop Building slab and the Manway/Power Tunnels from the Changehouse to the Service Shaft and from the Substation Building. Existing facilities are shown on Figures 4-1 (jacket map), 4-2 thru 4-5 and the facilities key (Table 4-1).

### 4.1.8 Concrete Batch Plant

The concrete batch plant produced 19,613 cubic yards of concrete during 1981 for on-Tract use. Bulk cement, sand, and aggregate, mixtures are transported to the site by truck, from Rifle or Meeker. Water for the batch plant operation is hauled from the well on Piceance Creek (24X25). Winterization of the batch plant was completed in 1981. See Figure 4-23. This work included installation of bifold doors and steam heaters on the sand/aggregate storage building. In the fall of 1981 operation and maintenance of the batch plant became the responsibility of the Operations/Maintenance Department.

### 4.1.9 Explosives Storage and Use

The explosive storage (powder magazine) area is, as shown on Figure 4-5, remotely located from areas of major activity. Approximately 98,600 lbs of explosives were consumed in shaft sinking and mine level station development activities in 1981. A total of approximately 550 blasts were detonated this year.

### 4.1.10 Water Treatment Facilities

The surface water facility is designed to dispose of excess mine water by direct discharge from the lower ponds (A & B) or by sprinkler irrigation or by subsurface reinjection into the same general zones being dewatered in the shafts. The system was initiated in 1979 for direct discharge from Ponds A & B into Little Gardenhire Gulch. In 1980 the sprinkler system was completed, tested and used throughout the summer. It was again in use during the summer of 1981. It consists of a lateral distribution system on the ridge between Cottonwood and Sorghum Gulches as shown in last year's annual report. Reinjection tests commenced in March of 1981. After this test period of about sixty days the reinjection system has been in almost constant use, except during July and part of August, when needed repairs and modifications were made to the system.

The pH of the mine water is controlled to $\leq 9$ at Ponds A & B by the addition of sulfuric acid. A storage tank and associated piping deliver acid as needed to lower the pH of the water at each pond. The pH is monitored at the overflow between Ponds A & B by a continuous pH meter. Grab samples are taken at other points in the ponds to assure that proper control of the pH is being maintained.

Suspended solids are settled out in Ponds A & B with addition of polymer flocculents. Nalco #8852 or Magnifloc #573-C have been used

with great success. This system consists of two 500 gallon mixing tanks and metering pumps which feed Ponds A & B. The Mud Cat shown on Figure 4-24 has also been utilized to clean settled solids from the ponds.

The gland seal pumps, located in the lower pond pump house, are in continuous operation to provide cooling water to those pumps which transfer mine water from the shafts to Ponds A & B.

The land application system was run from June until September and pumped approximately 440 gpm through two moveable nozzles, for a total of 39.7 million gallons. An aerial view of a portion of this system is shown on Figure 4-25.

The reinjection water treatment facility was tested and put into operation in 1981. Water from Pond B is pumped to Pond C and then flows through the Leau Claire upflow sand filter (Figure 4-26). The filter lowers the turbidity of up to 700 gpm to below 1 ntu. The filtered water is then reinjected with a centrifugal pump into Well 41X13-1 (Figure 4-27). A total of 98,944,528 gallons was reinjected during 1981.

A total of 634 million gallons from the shafts was treated and disposed by construction usage, discharge to surface streams under NPDES permit, irrigation, or reinjection during 1981. A complete breakdown of Tract water usage by month is given in Table 4-3 which includes yearly and yearly cumulative totals. Further water management aspects of this system are discussed in Section 7.2.

#### 4.1.11 Hydrology Laboratory

This lab is equipped with all the necessary laboratory and safety equipment and supplies to ensure the proper preparation and testing of field water samples (pH, temperature, conductivity and dissolved oxygen) as well as total dissolved solids and fluoride. Samples for additional water quality parameter determination are labeled, preserved and transported to Occidental's Grand Junction Laboratory for analysis.

#### 4.1.12 Summary of Engineering Status

##### 4.1.12.1 On-Site Engineering

The on-site engineering role changed during 1981 from design projects to emphasis on technical support and quality control. The following items were accomplished in 1981:

- Engineering on-site involved liaison with Colorado Ute/WREA in the construction and testing of the powerline from Meeker and the associated substation facilities.

- Design reviews of engineering contractor documentation were performed.

- Preliminary studies and design concepts were completed for possible future expansion of the reinjection facilities.

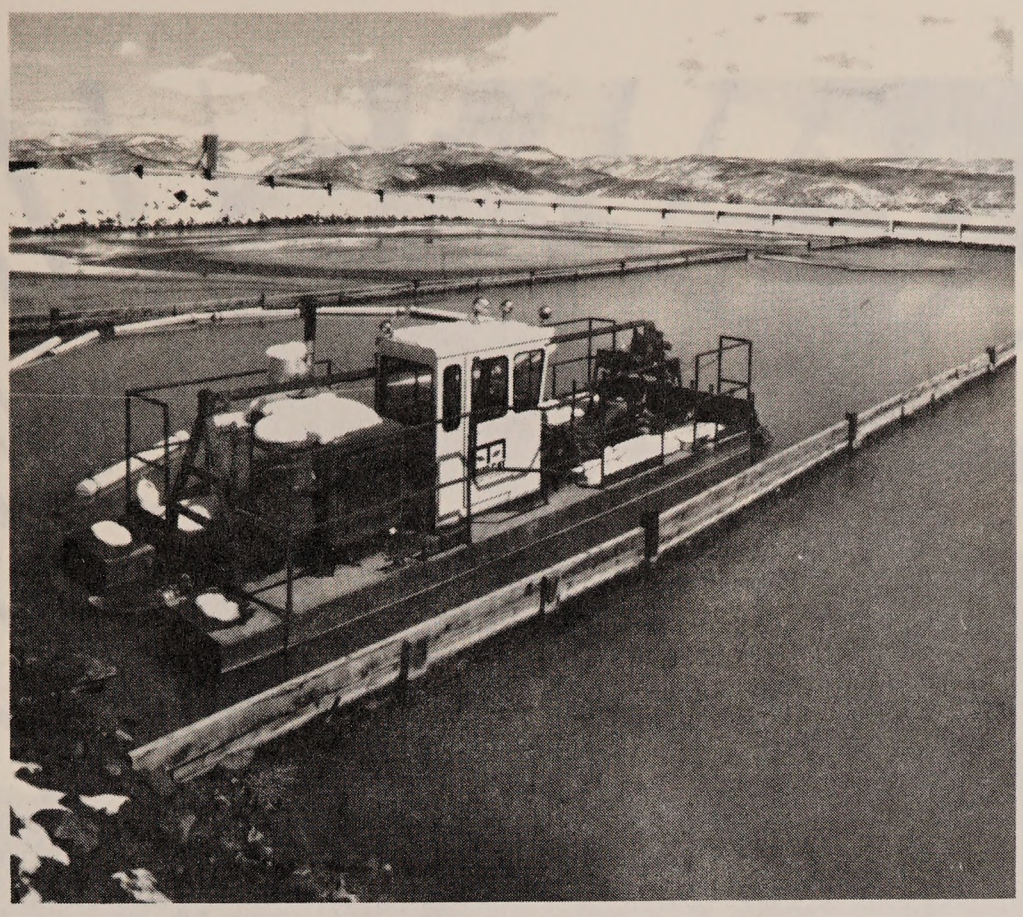


Figure 4-24. The mud cat on site in pond A utilized to remove suspended solids. (March 1981)

Figure 4-25. Aerial view of the land application system. (August 1981)

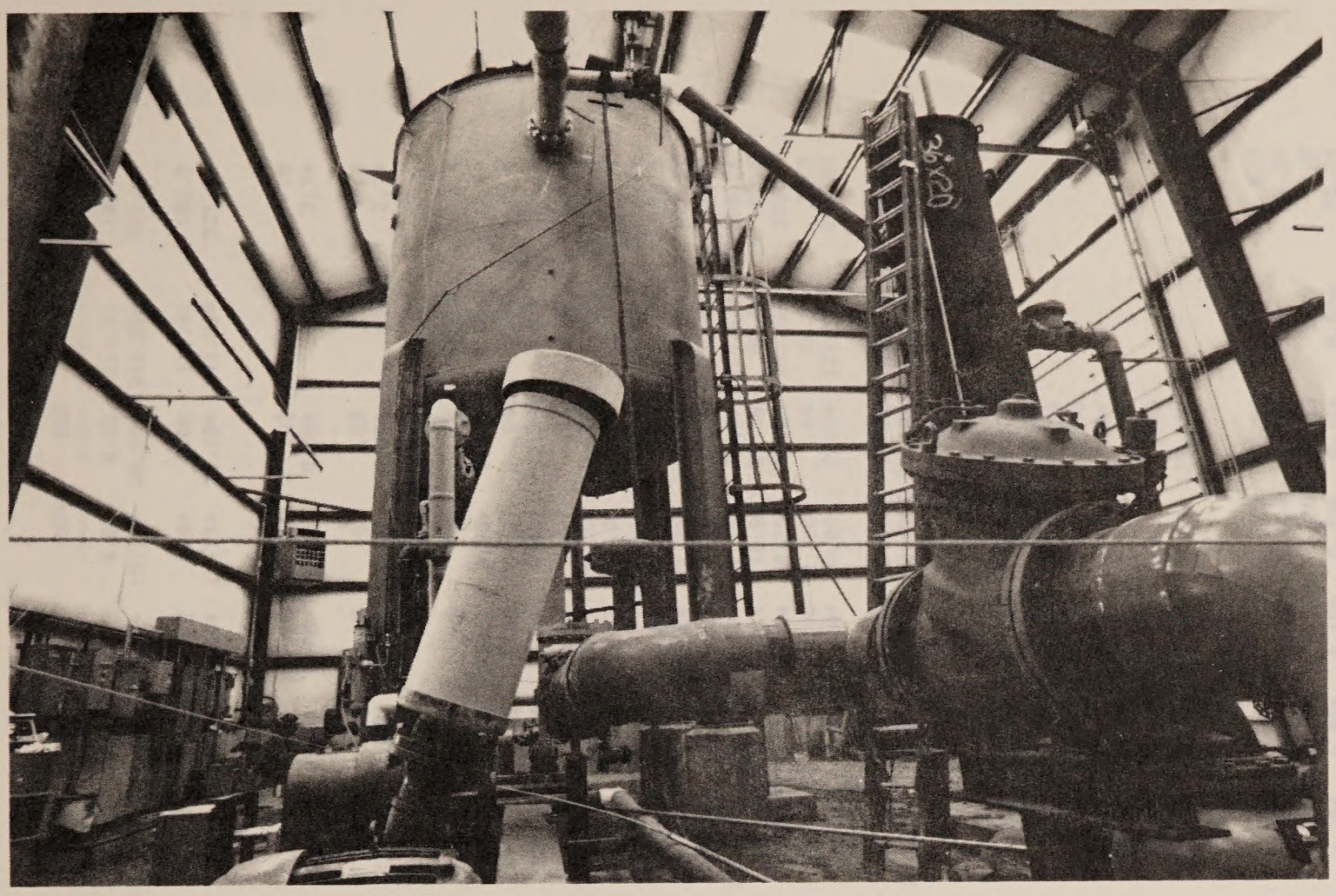


Figure 4-26. Operational L'eau Claire sand filter utlized for both the land application (sprinkler) system and test reinjection system. (February 1981)

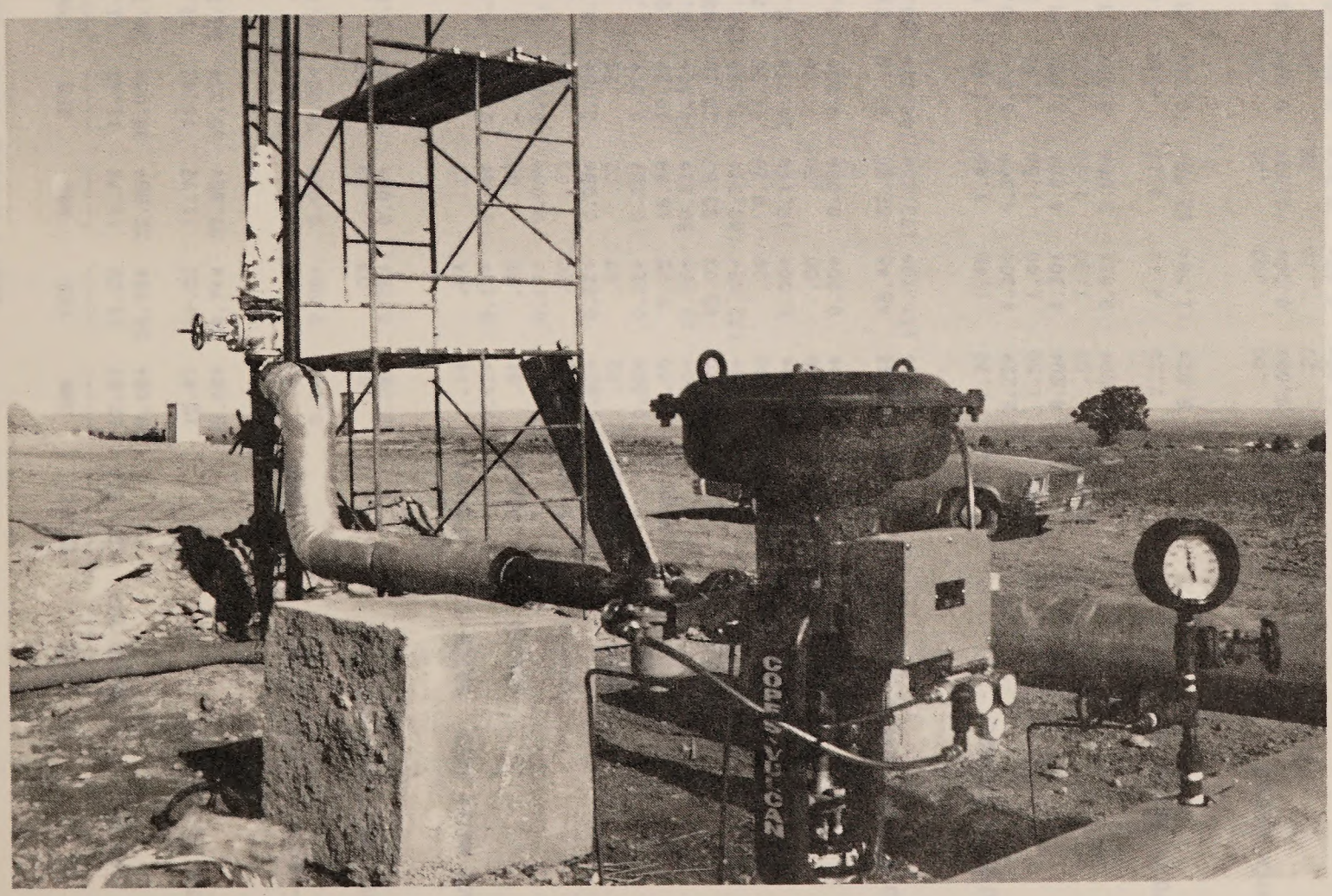


Figure 4-27. Last 30-day test set-up at the test reinjection well. (May 1981)

TABLE 4-3

1981 C-B WATER USAGE (10**6 GALLONS, * =ACRE FEET)

| | USE | SOURCE | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL YTD | TOTAL YRS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALL SHAFTS | GLAND WTR | PUMP STA | 12.87 | 11.32 | 11.72 | 11.42 | 11.99 | 9.68 | 10.36 | 10.18 | 3.62 | 4.66 | 4.94 | 8.66 | 111.41 | 182.9 |
| | | | 39.48* | 34.74* | 35.96* | 35.03* | 36.79* | 29.71* | 31.77* | 31.25* | 11.09* | 14.30* | 15.15* | 26.58* | 341.86* | 561.1* |
| *TOTAL ALL SHAFTS | | | 12.87 | 11.32 | 11.72 | 11.42 | 11.99 | 9.68 | 10.36 | 10.18 | 3.62 | 4.66 | 4.94 | 8.66 | 111.41 | 182.9 |
| | | | 39.48* | 34.74* | 35.96* | 35.03* | 36.79* | 29.71* | 31.77* | 31.25* | 11.09* | 14.30* | 15.15* | 26.58* | 341.86* | 561.1* |
| OFF-TRACT WTR USED | POTABLE | TOWN | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .32 | .9 |
| | | | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | .99* | 2.7* |
| *TOTAL OFF-TRACT WTR USED | | | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .03 | .32 | .9 |
| | | | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | 0.08* | .99* | 2.7* |
| TRACT WATER USED | BATCH PLNT | 24X-25 | .14 | .04 | .11 | .14 | .15 | .12 | .09 | .12 | .15 | .09 | .19 | .16 | 1.50 | 2.4 |
| | | | 0.42* | 0.13* | 0.34* | 0.43* | 0.45* | 0.37* | 0.28* | 0.37* | 0.46* | 0.28* | 0.59* | 0.48* | 4.60* | 7.4* |
| | CONSTR | PONDS | .01 | .06 | .03 | .03 | .37 | .27 | 1.53 | 1.43 | .10 | .00 | .07 | .04 | 3.94 | 18.0 |
| | | | 0.04* | 0.17* | 0.09* | 0.08* | 1.15* | 0.84* | 4.68* | 4.38* | 0.30* | 0.00* | 0.23* | 0.12* | 12.08* | 55.1* |
| | CONSTR | 24X25 | .27 | .20 | .03 | .03 | .03 | .03 | .25 | .14 | .14 | .07 | .07 | .07 | 1.33 | 1.3 |
| | | | 0.82* | 0.62* | 0.09* | 0.08* | 0.10* | 0.10* | 0.77* | 0.43* | 0.43* | 0.22* | 0.20* | 0.22* | 4.07* | 4.1* |
| | DUST CNTL | PONDS | .02 | .07 | .02 | .29 | .40 | .54 | .35 | .27 | .30 | .06 | .05 | .00 | 2.36 | 6.5 |
| | | | 0.06* | 0.22* | 0.06* | 0.91* | 1.22* | 1.66* | 1.06* | 0.82* | 0.91* | 0.17* | 0.14* | 0.00* | 7.23* | 19.8* |
| | EVP & LEAK | POND C | .00 | 6.05 | 16.56 | 10.23 | 8.77 | 10.91 | 11.19 | 11.19 | 5.46 | 7.68 | 7.49 | 7.92 | 103.47 | 103.5 |
| | | | 0.00* | 18.55* | 50.82* | 31.40* | 26.92* | 33.49* | 34.33* | 34.35* | 16.77* | 23.58* | 22.98* | 24.32* | 317.49* | 317.5* |
| | NPDES REL | PONDS | 58.20 | 43.03 | 33.67 | 25.20 | 49.51 | 32.18 | 33.00 | 42.04 | 12.66 | .36 | .69 | .00 | 330.54 | 654.7 |
| | | | 178.58* | 132.03* | 103.31* | 77.32* | 151.90* | 98.75* | 101.26* | 129.00* | 38.84* | 1.10* | 2.12* | 0.00* | 1014.23* | 2,008.8* |
| | REINJECT | PONDS | .00 | .00 | 6.24 | 11.26 | 2.74 | 12.60 | 1.67 | .32 | 4.54 | 19.44 | 18.98 | 21.16 | 98.94 | 98.9 |
| | | | 0.00* | 0.00* | 19.14* | 34.55* | 8.39* | 38.66* | 5.13* | 0.99* | 13.93* | 59.64* | 58.24* | 64.92* | 303.60* | 303.6* |
| | SPR IRRIG | POND C | .00 | .00 | .00 | .00 | .00 | 8.42 | 15.13 | 14.54 | 1.64 | .00 | .00 | .00 | 39.74 | 79.1 |
| | | | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 25.85* | 46.42* | 44.63* | 5.04* | 0.00* | 0.00* | 0.00* | 121.93* | 242.6* |
| *TOTAL TRACT WATER USED | | | 58.64 | 49.45 | 56.66 | 47.18 | 61.96 | 65.09 | 63.20 | 70.06 | 24.99 | 27.69 | 27.54 | 29.35 | 581.80 | 964.3 |
| | | | 179.93* | 151.73* | 173.85* | 144.78* | 190.12* | 199.72* | 193.93* | 214.96* | 76.68* | 84.98* | 84.50* | 90.06* | 1785.23* | 2,958.8* |
| WATER IN STORAGE | - | POND A | 1.70 | 1.40 | 1.40 | 1.60 | 1.70 | 1.60 | 1.70 | 1.50 | 1.20 | 1.50 | 1.50 | 15.00 | | |
| | | | 5.22* | 4.30* | 4.30* | 4.91* | 5.22* | 4.91* | 5.22* | 4.60* | 3.68* | 4.60* | 4.60* | 46.03* | | |
| | - | POND B | 1.50 | 1.40 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 15.00 | | |
| | | | 4.60* | 4.30* | 4.60* | 4.60* | 4.60* | 4.60* | 4.60* | 4.60* | 4.60* | 4.60* | 4.60* | 46.03* | | |
| | - | POND C | .00 | 1.30 | 1.20 | 1.30 | 1.30 | 1.30 | 1.30 | 1.50 | 1.50 | 1.30 | 1.40 | 12.00 | | |
| | | | 0.00* | 3.99* | 3.68* | 3.99* | 3.99* | 3.99* | 3.99* | 4.60* | 4.60* | 3.99* | 4.30* | 36.82* | | |
| *TOTAL WATER IN STORAGE | | | 7.20 | 4.10 | 4.10 | 4.40 | 4.50 | 4.40 | 4.50 | 4.50 | 4.20 | 4.30 | 4.40 | 42.00 | | |
| | | | 9.82* | 12.58* | 12.58* | 13.50* | 13.81* | 13.50* | 13.81* | 13.81* | 12.89* | 13.19* | 13.50* | 128.87* | | |
| WATER PUMPED | - | 33X-1 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | | 4.3 |
| | | | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | | 13.3* |
| | - | 24X-25 | .27 | .20 | .26 | .26 | .30 | .32 | .34 | .26 | .29 | .16 | .26 | .23 | 3.16 | 7.5 |
| | | | 0.82* | 0.62* | 0.81* | 0.81* | 0.92* | 0.99* | 1.05* | 0.79* | 0.89* | 0.49* | 0.79* | 0.70* | 9.69* | 23.2* |
| | - | 32X-12 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | | 5.9 |
| | | | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | 0.00* | | 18.0* |
| | - | V/E SHAFT | 47.12 | 43.73 | 33.44 | 36.94 | 45.96 | 31.35 | 45.99 | 45.43 | 2.36 | .00 | .00 | .00 | 332.33 | 678.9 |
| | | | 144.58* | 134.18* | 102.62* | 113.36* | 141.04* | 96.18* | 141.11* | 139.41* | 7.26* | 0.00* | 0.00* | 0.00* | 1019.73* | 2,083.1* |
| | - | PROD & SERV | 26.05 | 23.14 | 28.44 | 11.27 | 26.78 | 21.08 | 24.32 | 23.50 | 24.00 | 27.84 | 28.26 | 34.26 | 298.93 | 522.4 |
| | | | 79.92* | 71.01* | 87.25* | 34.58* | 82.18* | 64.69* | 74.61* | 72.09* | 73.63* | 85.44* | 86.72* | 105.11* | 917.23* | 1,602.9* |
| *TOTAL WATER PUMPED | | | 73.43 | 67.07 | 62.14 | 48.48 | 73.05 | 52.75 | 70.64 | 69.19 | 26.65 | 28.00 | 28.52 | 34.48 | 634.41 | 1,219.0 |
| | | | 225.32* | 205.81* | 190.68* | 148.75* | 224.14* | 161.86* | 216.77* | 212.29* | 81.78* | 85.93* | 87.51* | 105.81* | 1946.65* | 3,740.4* |

- Two further reinjection wells were drilled to approximately 1,600 feet for possible future use.

- Three core holes were drilled to approximately 1,600 feet. The sample cores are undergoing mineralogical and geological analysis. Interpretation of the findings will provide additional valuable information of the geological nature of the Tract.

- Quality control efforts were provided for all construction activities covering civil, structural, mechanical, piping and electrical/instrumentation work.

- A fully equipped laboratory was installed and utilized for concrete testing.

- Using assistance from outside firms quality control procedures for structural fill and soil analyses were instituted.

#### 4.1.12.2 Off-Site Engineering

##### 4.1.12.2.1 Fluor

Fluor Engineers and Constructors, Inc., Houston Division, under contract to Cathedral Bluffs, performed engineering work that resulted in the following reports and estimates:

1. Estimates of Costs of Aboveground Shale Retorting (AGR) Processes (August, 1981).

2. Process Design Package and Cost Estimate for MIS Surface Process Facilities for First Phase and Total Project.

3. Process Design Package and Cost Estimate for AGR Support Facilities for First Phase and Total Project.

4. Offgas Desulfurization Process Selection Report.

5. Process Flow Diagrams and Emission Data for the PSD Permit Application.

##### 4.1.12.2.2 Parsons

The Ralph M. Parsons Company, Pasadena, California, under contract to Cathedral Bluffs, prepared the following two reports on the evaluation of sulfur control systems:

1. Evaluation and Comparison of Sulfur Dioxide Emission Control Systems, May, 1981.

2. Flue Gas Desulfurization Process Selection, June, 1981.

#### 4.1.12.2.3 Stearns-Roger

Stearns-Roger, Denver, prepared the Process Design Package and Capital and Operating Cost Estimate for a 12,800 tons per stream day (TPSD) Union B Retort.

#### 4.1.12.2.4 Bechtel

Bechtel, Toronto, prepared a conceptual design package and cost estimates for surface material handling facilities to feed one AGR in the first phase, and six AGR's in the final phase of the project. Detailed engineering work was started on the first leg of the conveyor system from Production Shaft to truck loadout bins. A crushing and screening testwork was also undertaken using C.B. shale with the help of Bechtel personnel to determine the suitability of equipment to be utilized in the AGR feed preparation facilities. The testwork was performed at the test facilities of four different vendors. Bechtel developed emission data from surface materials handling points for the PSD permit.

#### 4.1.12.2.5 Development Engineering Incorporated (DEI)

DEI prepared a report on a Detailed Laboratory Examination of C.B. shale. The purpose of this laboratory analysis was to determine the suitability of retorting C.B. shale in the Paraho DH Retort.

#### 4.1.12.2.6 Dames and Moore

Dames and Moore, under contract with C.B., carried out the soils investigation in the surface process area and prepared a soils report.

#### 4.1.12.2.7 Technology Management Inc.

Oil/Water Separation Study Conducted studies on MIS oil shale emissions with and without deemulsifiers.

#### 4.1.12.2.8 Williams Brothers Engineering

Shale Oil Rheology - Study of MIS shale oil hydraulics. Pipeline Transportation of Shale Oil, Phase II: Shale Oil Rheology, Phase III: Pipeline Conceptural Design.

#### 4.1.12.2.9 Resources Conservation Company (RCC)

Resources Conservation Company of Seattle, Washington, prepared the following water related reports for C.B. in 1981:

1. Cathedral Bluffs Oil Shale Facility Proposed Water Management System.

2. Interim Report, Fluoride Removal Project Engineering Evaluation.

An additional study was performed to determine the optimum method of producing potable water from mine water.

#### 4.1.12.2.10 Stanford Research Institute (SRI) International

SRI International of Menlo Park, California, performed a water treatability study of process condensate in the following areas:

1. Steam Stripping, Single and Two Stage.
2. Fine Oil Removal.
3. Granular Activated Carbon Adsorption.

#### 4.1.12.2.11 Brown and Caldwell

Brown and Caldwell of Walnut Creek, California, performed biological water treatment study on process condensate.

#### 4.1.12.2.12 Institute of Gas Technology (IGT)

Institute of Gas Technology conducted the burner tests on simulated MIS offgas using an American Schack burner. The report entitled "Evaluation of Burners for Utilization of Offgas from Shale Gasification" was issued in December, 1981.

#### 4.1.12.2.13 Arthur D. Little, Inc.

Arthur D. Little, Inc. conducted a marketing study for by-products and raw materials under a subcontract to Fluor Engineers and Constructors, Inc., (September, 1981) for Cathedral Bluffs.

### 4.1.13 Permanent Mine Support Buildings

In June, 1981 topsoil removal and earthwork began in preparation for the construction of two major mine support buildings, the Maintenance Shop/Warehouse and the Changehouse/Operations Building. Twelve feet of backfill material from Brown and Root's cut bank material were installed to bring the Shop/Warehouse to its design elevation. In July, drilling and concrete placement of caissons for ground support for the two buildings began and was completed in October. See Figures 4-28 to 4-30 for construction progress.

At the Shop/Warehouse footings and stemwalls were placed on all four sides except the northwest corner. In October, slabwork began as concrete was placed in checkerboard fashion through the remainder of the year. Underground sewer and exhaust piping was installed, tested, and backfilled.

Concrete placement of footings and highwalls for the Changehouse/Operations building began in September, and walls on the north and

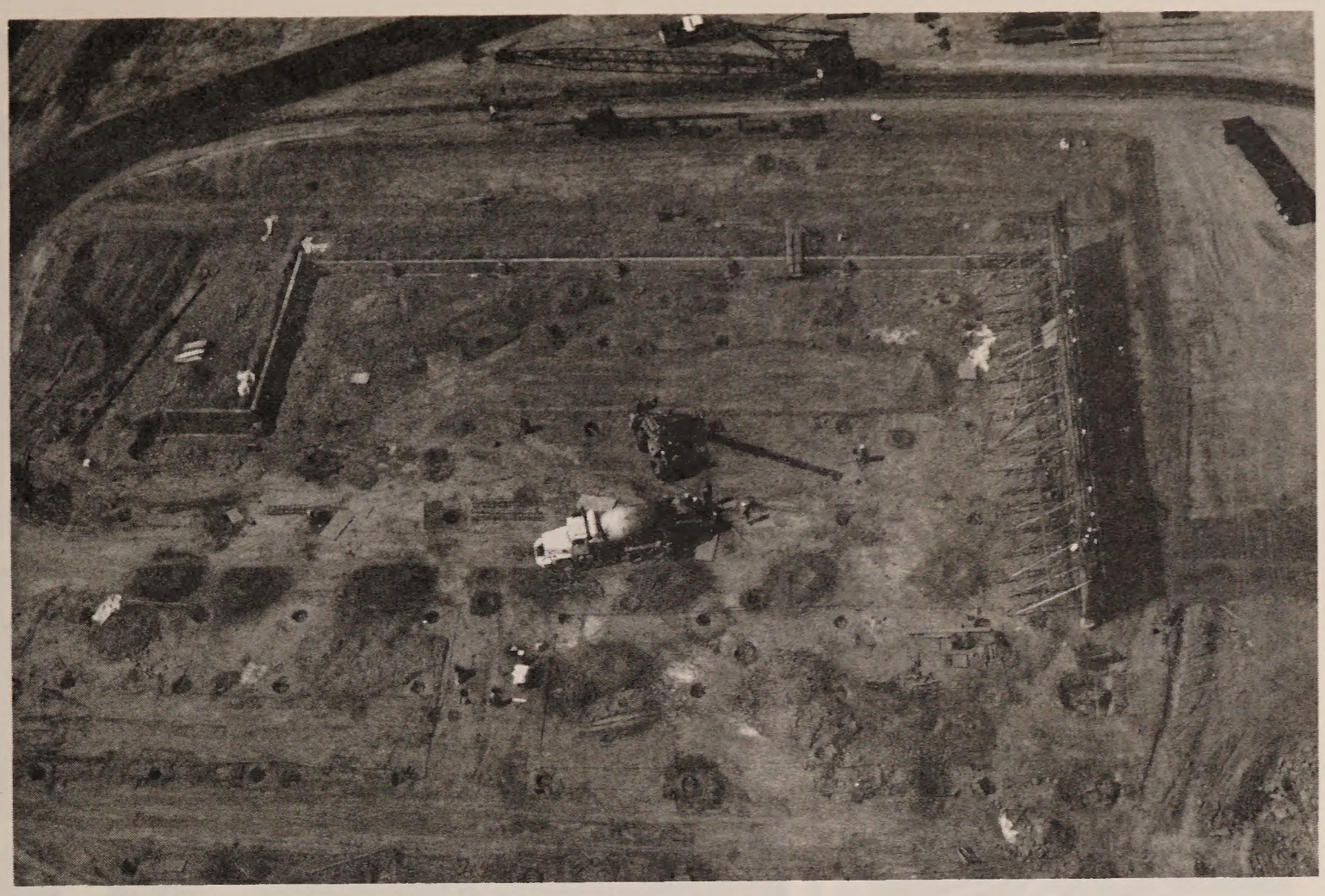


Figure 4-28. Pouring footings for the changehouse/operations building. (September 1981)

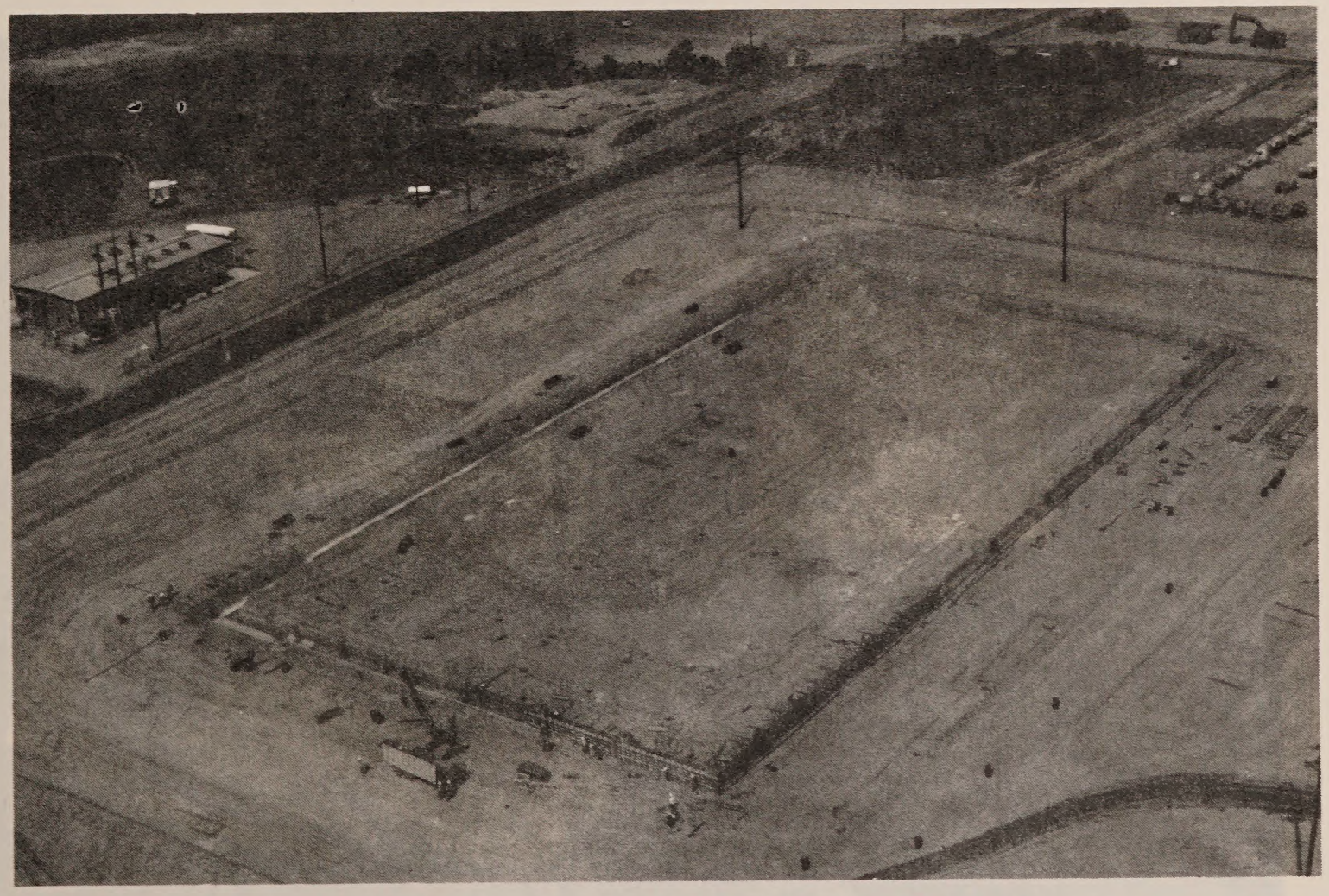


Figure 4-29. Pouring footings for the maintenance shop/warehouse building. (September 1981)

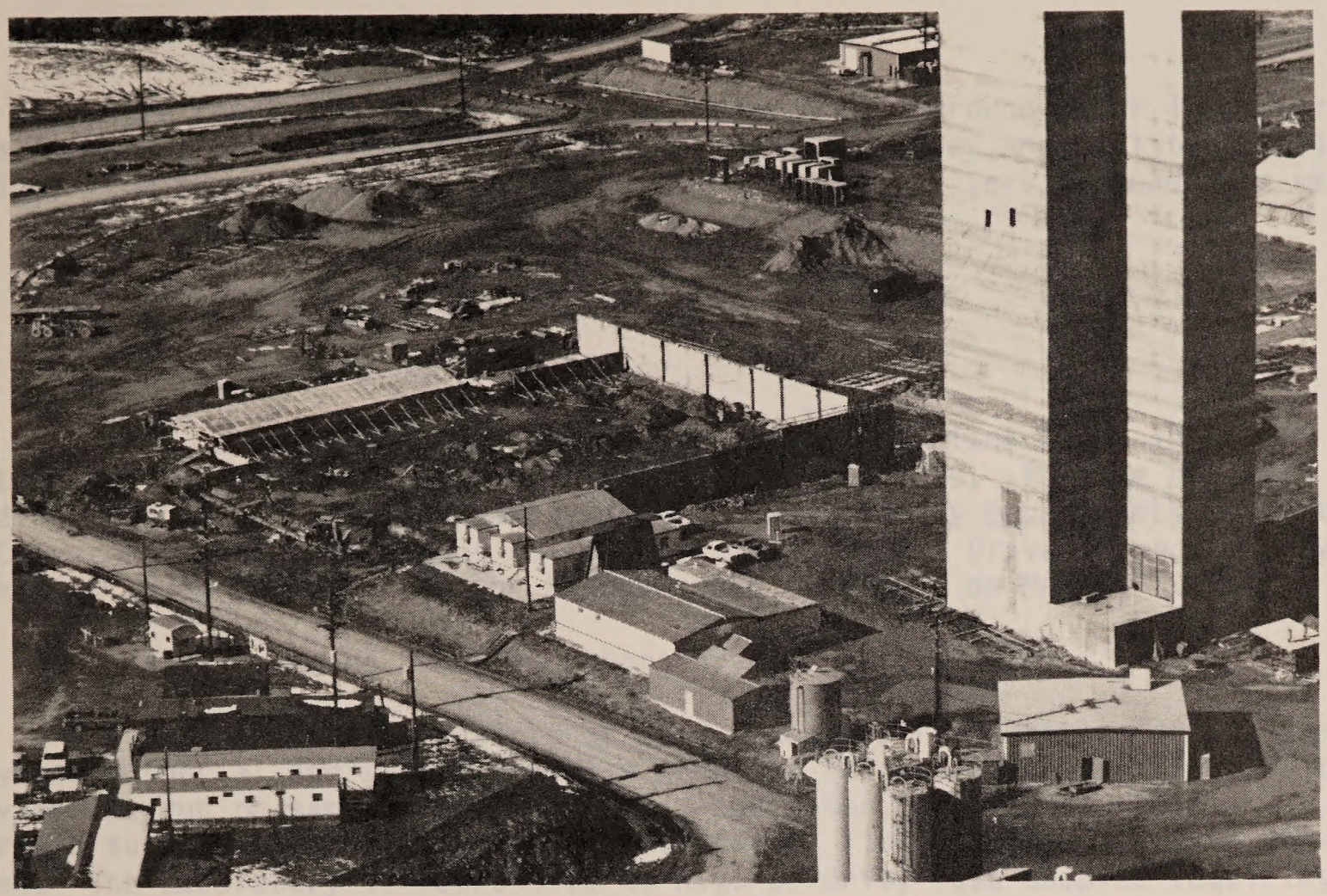


Figure 4-30. Aerial view of construction near the headframes. (October 1981)

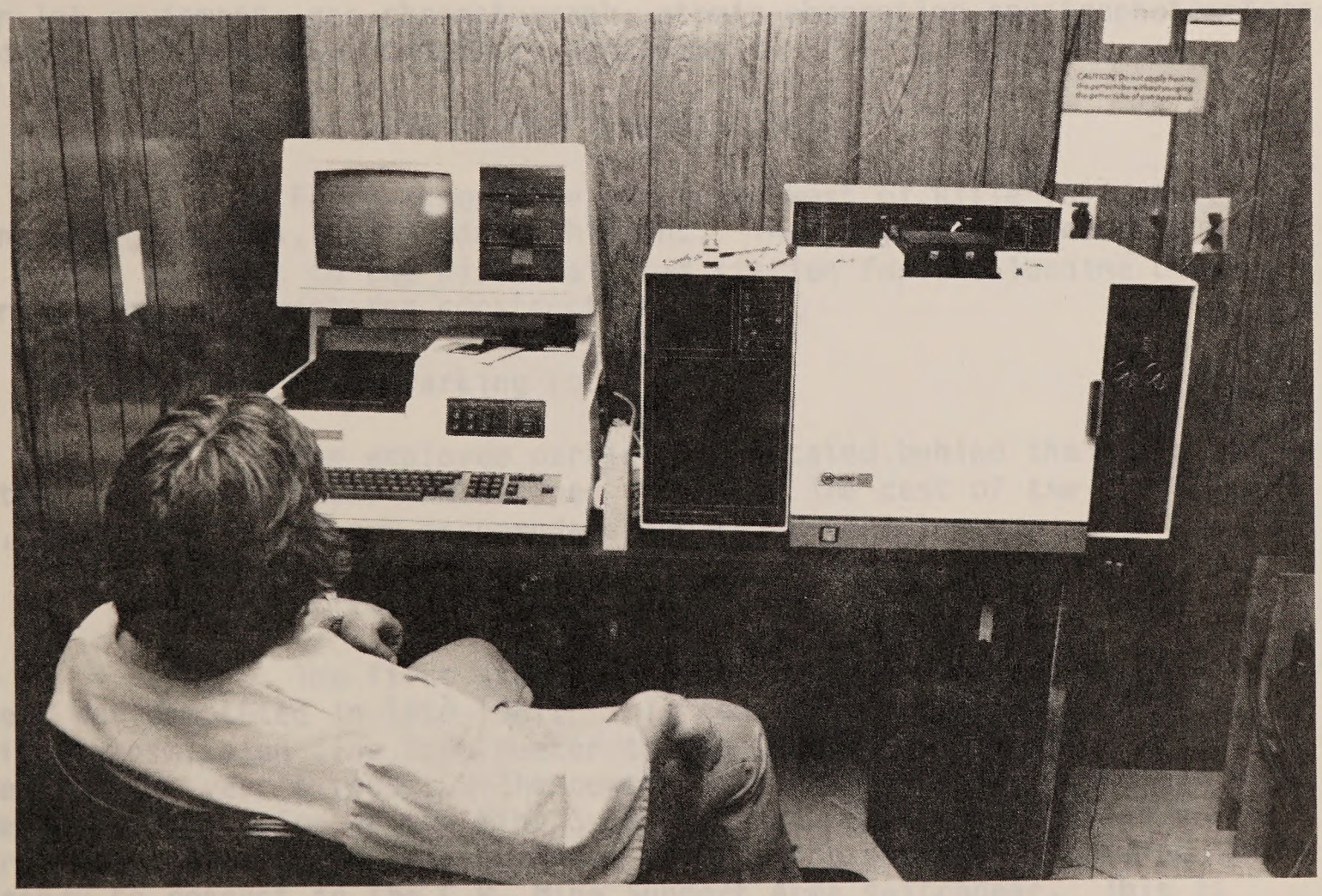
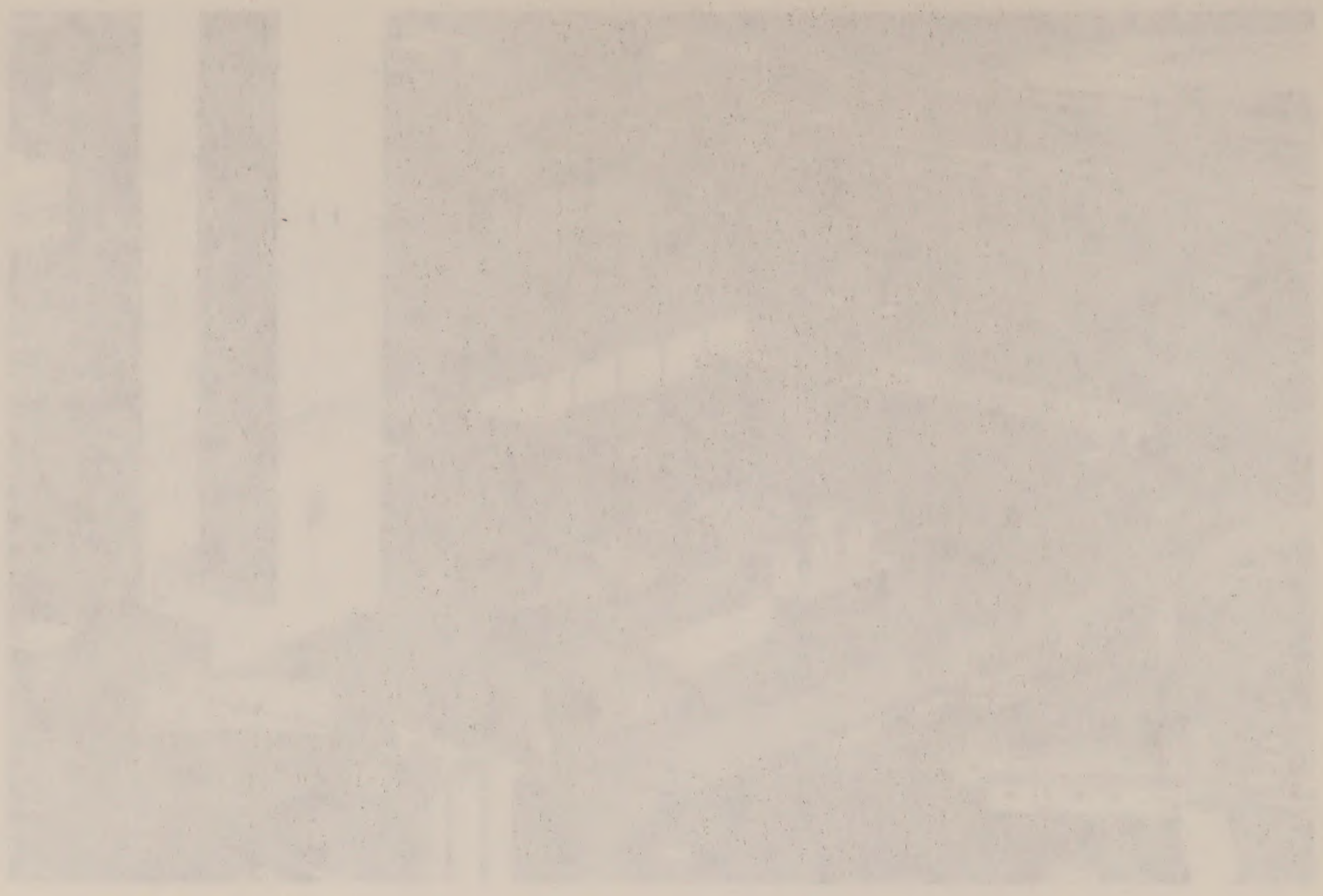


Figure 4-31. Gas chromatograph, processor and display - Grand Junction Laboratory.



east side were completed by the end of the year. Underground sewer lines were installed and slabwork was well under way. Precast manway and utility tunnel sections from the Changehouse/Operations building to the Service headframe were laid side by side, grouted, and backfilled.

## 4.2 Off-Tract Facilities Description

### 4.2.1 Grand Junction Office

The headquarters facility at 751 Horizon Court in Grand Junction has been in continuous use since January of 1979. Because of overcrowding, the Accounting and Health, Safety, and Security Departments moved to the Crossroads Business Commons Building at 2764 Compass Drive (approximately one-half mile to the north of the headquarters facility) on May 1, 1981.

### 4.2.2 Grand Junction Laboratory

This laboratory at 2372 G Road is responsible for analyzing the various special and routine samples received from the Cathedral Bluff site. Analyses are run on samples of shale, gas, and water, as well as other materials such as sludges, slimes, and minerals. Fisher assays are also performed. The Laboratory is responsive to high priority rush samples requiring short turn-around times for analysis. Routine samples are analyzed and reported within 3 to 4 weeks of receipt. The Laboratory has a stringent quality control program and high standards of accuracy which have resulted in the State of Colorado drinking water certification for Schedule I contaminants other than bacteriology and pesticides. Figures 4-31 to 4-33 show some of the major lab equipment: gas chromatograph, atomic absorption spectrophotometers, and distillation and wet chemistry apparatus.

### 4.2.3 Rifle Warehouse and Rail Siding

Forty acres were purchased west of Rifle for future rail siding, staging area, and product shipment. The project continues to use a rail siding adjacent to the Rifle railroad station for off loading bulk materials and equipment for construction.

### 4.2.4 Rifle Parking Lot

The employee parking lot located behind the Rifle Gap Apartment units was paved and striped in 1981. The cost of the project was $256,000. The lot can now accommodate about 340 vehicles.

### 4.2.5 Utility Corridors

The first stage of the electric power supply system for the project was completed in late 1981. This consists of a single 138,000 volt, 22-mile transmission line from Meeker to the C.B. site. The routing was discussed in last year's report. The power line attaches to a 30,000 KVA transformer in a Substation at the Mine Support Area. Power was applied to the power line/Substation in late December for testing purposes. This equipment is now ready to connect to the C.B. Mine Support Area switchgear. This is expected to take place in early 1982.

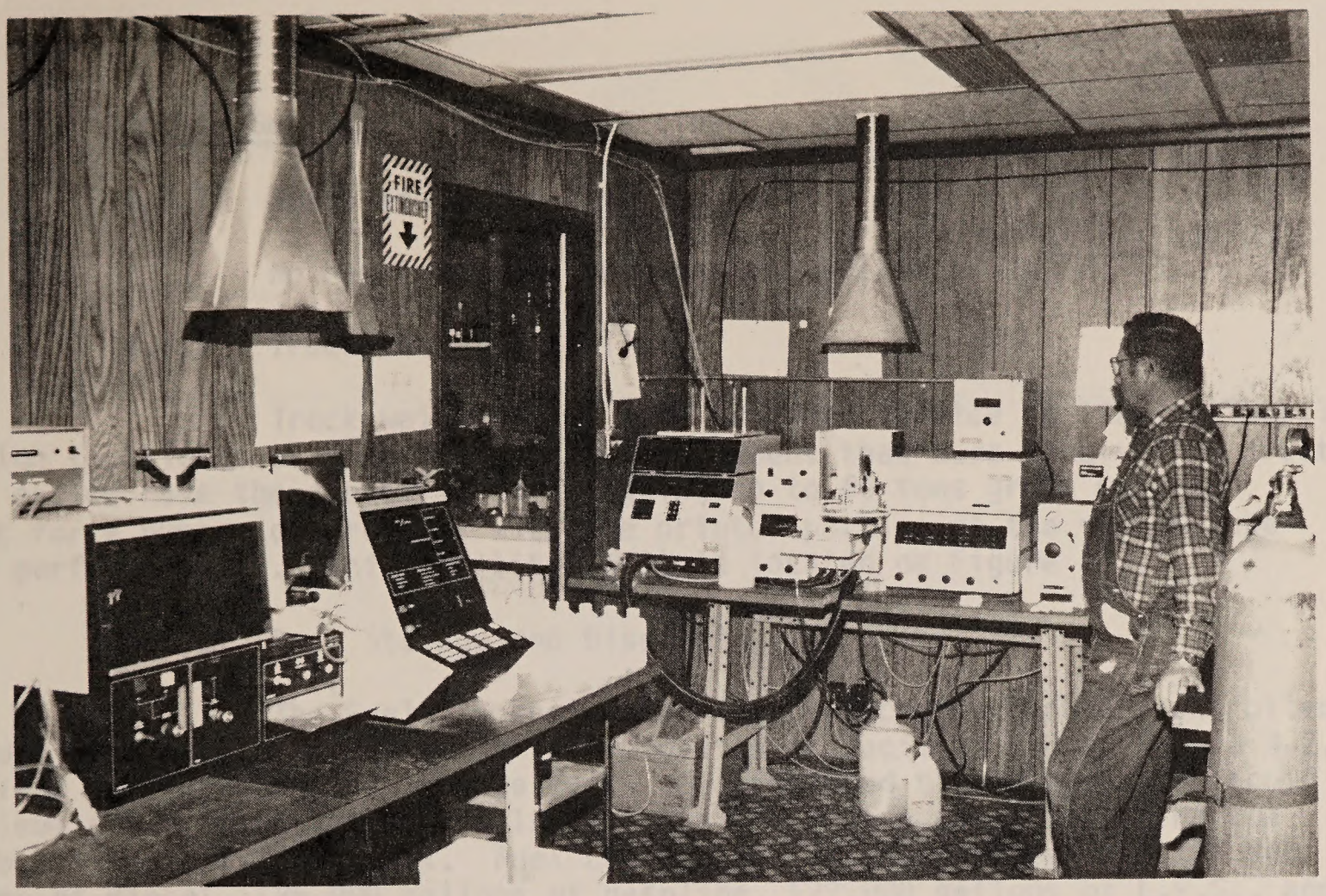



Figure 4-32. Atomic absorption spectrophotometers - Grand Junction Laboratory.

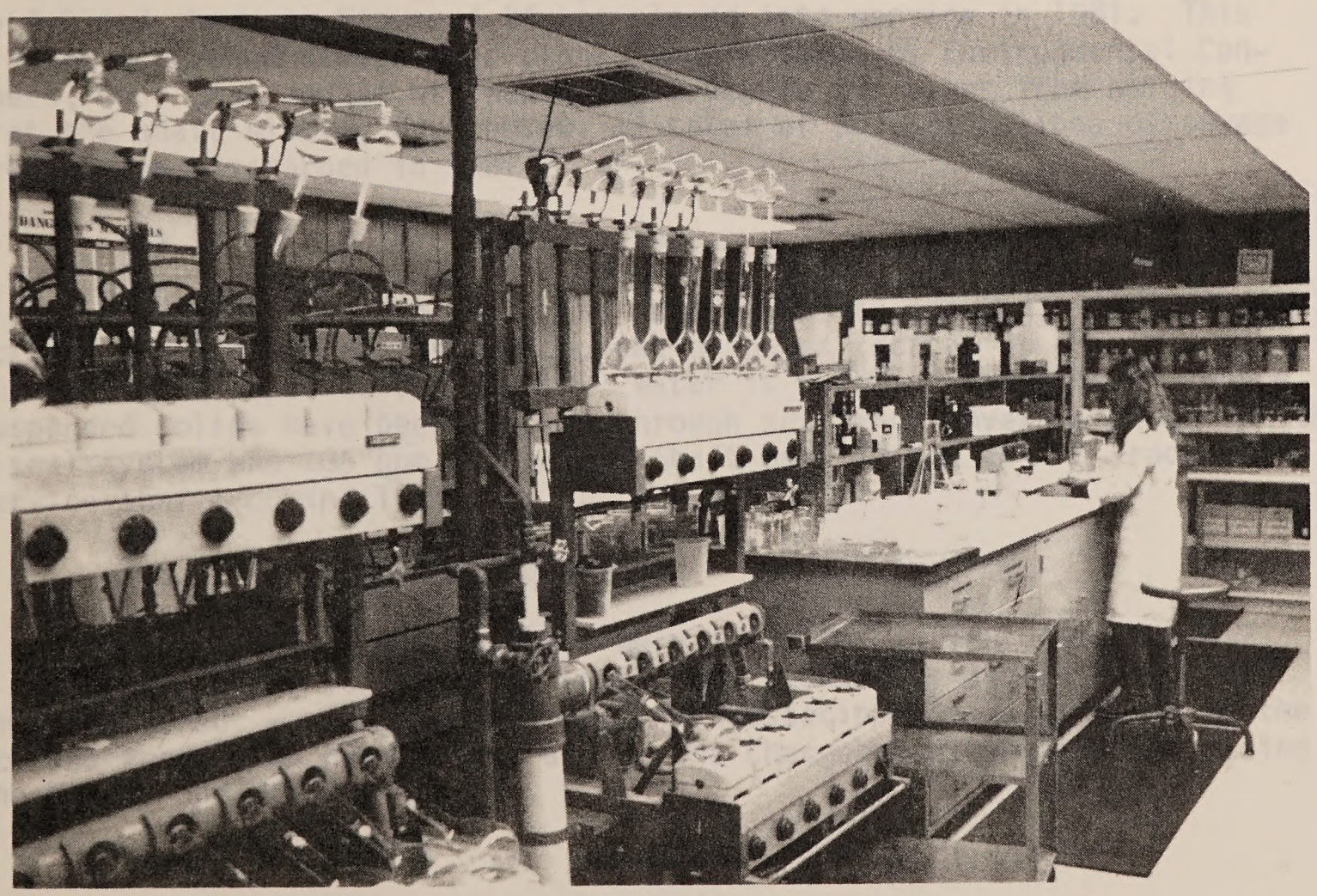
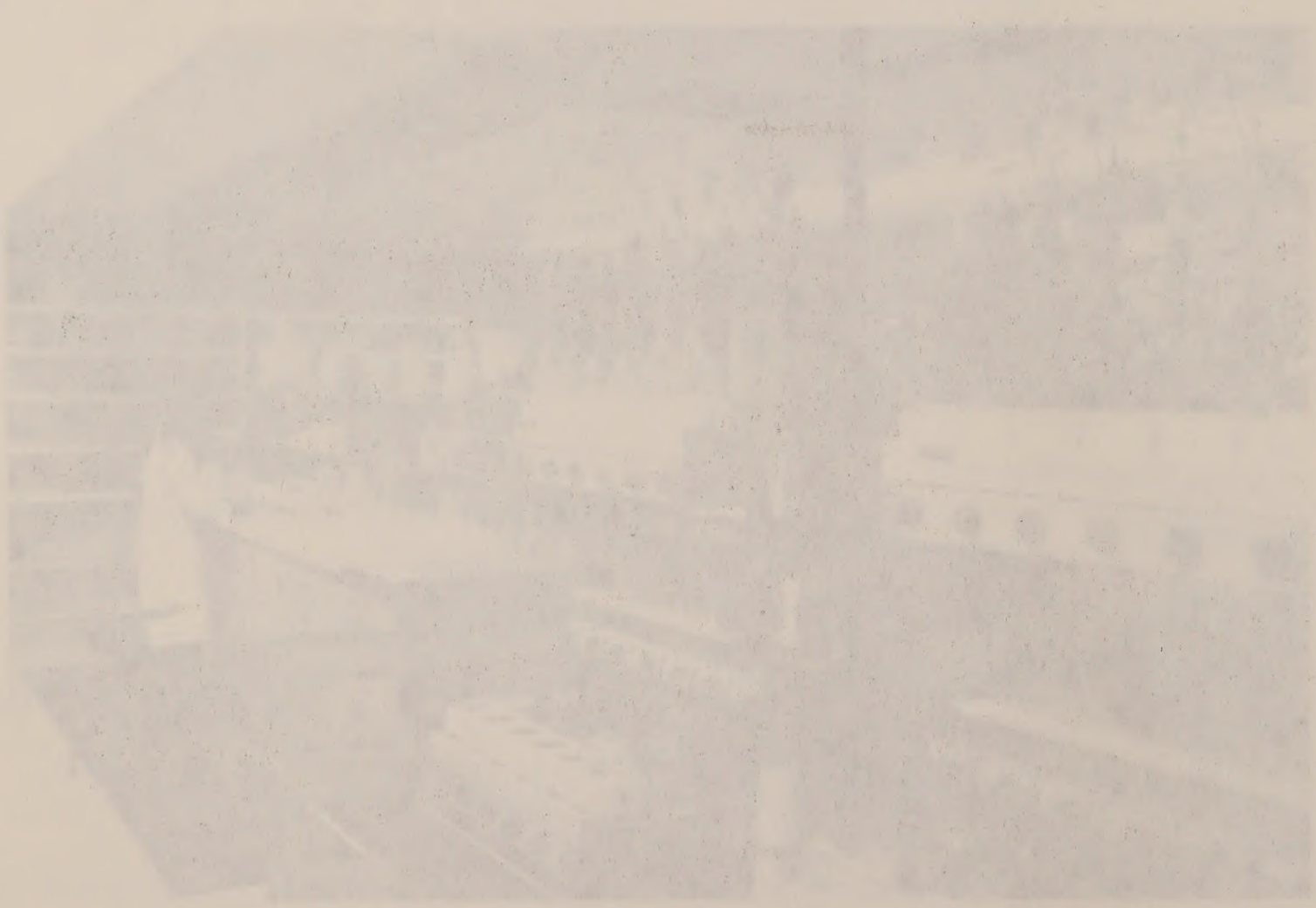


Figure 4-33. Distillation and wet chemistry apparatus - Grand Junction Laboratory.



## 4.3 Access/Service/Support/Activities

### 4.3.1 Roads and Guard Rails

No new road work was done in 1981.

### 4.3.2 Truck Weighing Facility

Truck weigh scales were put into service in 1981, primarily to weigh truckloads of sand, aggregate, and cement that were received on Tract. These scales have the capability of weighing up to 60 tons gross weight. Except for a number of problems with the printer portion of the system, the scale performed well. This facility (#45) is located on Figure 4-3.

### 4.3.3 Fuel Storage and Dispensing

The Fuel Dispensing Facility, which is computer controlled, was put into service in 1981. It is designated as facility #16 on Figure 4-2. Diesel as well as gasoline storage tanks are connected to the system. Liquid petroleum gas storage tanks are also on site to provide gas for heating the site buildings and facilities. Fuel consumption during the year was 286,000 gallons of diesel, 126,000 gallons of gasoline, 177,000 gallons of L.P.G., and 400,000 mm BTU's of natural gas as indicated on Table 4-4.

### 4.3.4 Sewage Treatment Facility

A 9,000 gpd packaged Sewage Treatment Plant located on Figure 4-3 and shown on Figure 4-34 was placed into service in 1981. This plant is an activated sludge type plant, manufactured by Environmental Conditioners, Inc. Raw sewage was hauled by truck to the plant from holding tanks at the shaft sinking dry houses. A total of 607,331 gallons of sewage was treated and discharged in 1981.

### 4.3.5 Gland Seal Water System

Water for the gland seal system to the Ventilation/Escape, Production, and Service Shafts is supplied by pumps located at the lower pond pump house and is piped to the shafts. Water is supplied from Pond B, where the suspended solids have been removed through settling. Average usage for the gland seal system was 136 gpm at the V/E Shaft and 122 gpm at the Production and Service Shafts during 1981.

### 4.3.6 Fire Water Loop System

As utility tunnels were installed in 1981 (Figures 4-2, 4-21, and 4-22) piping for the fire water loop system was installed adjacent to them. A hydrant was located at the mine substation, lines were run to the Service and Production headframes, and to the Changehouse/Operations Building via the Manway and Utility Tunnels.

### 4.3.7 Pipelines

Natural gas lines were installed adjacent to the Utility Tunnels in 1981. A line between the Production Shaft and the proposed Boiler/

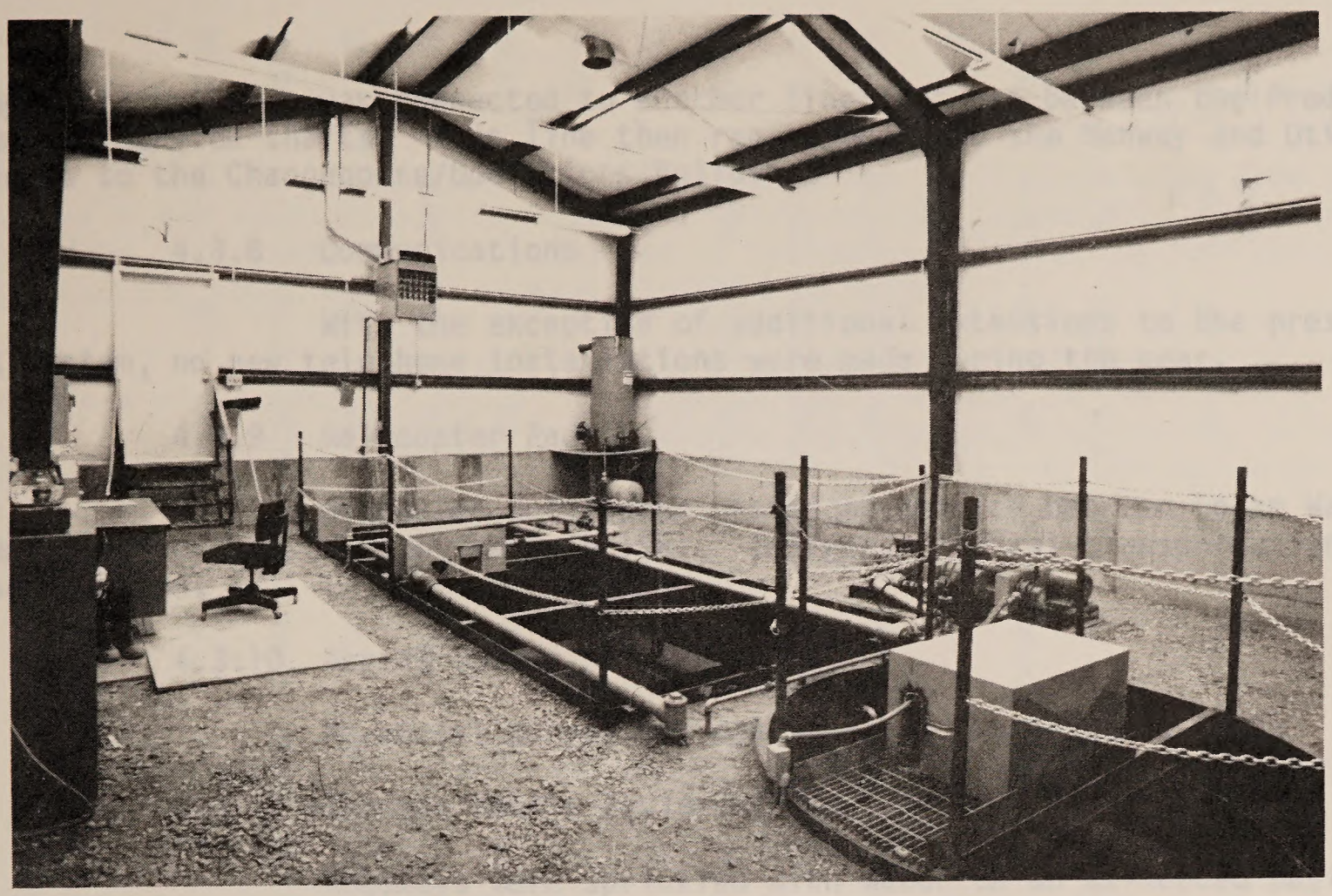


Figure 4-34. Interior of the completed 9,000 gal/day sewage treatment plant. (March 1981)

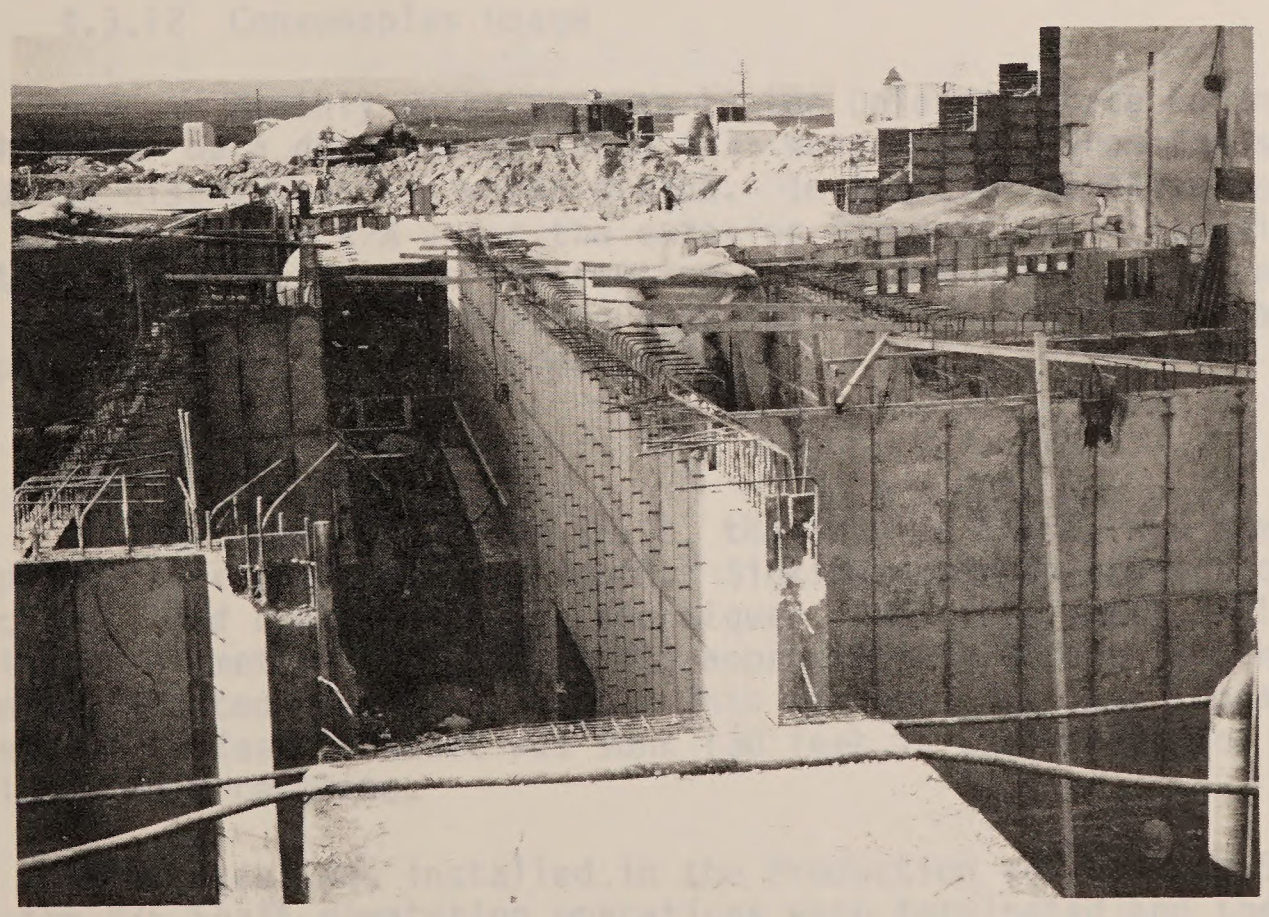


Figure 4-35. Airlock at the subcollar level at the service shaft. (December 1981)

Compressor Building was connected to another line that ran between the Production and Service shafts. This line then ran adjacent to the Manway and Utility Tunnels to the Changehouse/Operations Building.

4.3.8 Communications

With the exception of additional extensions to the present PBX system, no new telephone installations were made during the year.

4.3.9 Helicopter Pad

Scheduled helicopter passenger service between Logan Wash, Grand Junction and C-b continued in 1981. Emergency medical transportation was also provided.

4.3.10 Aerial Survey

No aerial survey was done for the C-b Tract in 1981.

4.3.11 Surface Mobile Equipment

Roadways were sprinkled with water on an as-needed basis (usually daily) during the summer months. Dust suppressant (Coherex/water mix) was applied on a scheduled basis or as conditions dictated. A road grader maintained the road surface, and loaders and trucks were used on an as-needed basis to clean ditches, culverts, etc. Snow removal and road-sanding crews were on 24-hour call for road maintenance during winter months.

4.3.12 Consumables Usage

Monthly water reports to the Colorado State Engineer include the water data depicted on Table 4-3: water pumped from the shafts, water used and discharged, and water stored. In addition to these data, quarterly reports to the EPA under the existing Prevention-of-Significant-Deterioration permit report the information on Table 4-4 for additional consumables: fuels, acid and flocculants, dust palliatives, shaft rock and shale mined, explosives used, and disturbed acreage.

## 4.4 Mining

In 1981, the Production Shaft, the Service Shaft, and the Ventilation/Escape Shaft reached terminal depth. Sinking employed conventional drill, blast, muck-out, and concrete lining techniques. Multiple small drill holes (under 2 inches diameter) were drilled in approximately 8-foot lengths, filled with dynamite, blasted, and mucked-out. This sequence was then repeated; after each successive 25 feet of shaft was sunk (30 feet in the Production Shaft), it was then lined with concrete.

Shaft steel was installed in the Production and Service Shafts in 1981. In the V/E Shaft dewatering operations were terminated and the shaft allowed to flood as of September so as to alleviate the need to discharge from Pond B to Piceance Creek via Little Gardenhire.

TABLE 4-4

1981 C.B. Consumable Usage

| | USE | SOURCE | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL YTD | TOTAL YRS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WTR TREATMENT-ACID | POND A&B | 10**3 GAL | 7.75 | 5.77 | 7.62 | 4.33 | 5.56 | 1.40 | 1.65 | 4.65 | 1.39 | 2.06 | 4.12 | 1.44 | 47.73 | 109.81 |
| DIESEL FUEL #1 | - | 10**3 GAL | .12 | .08 | .00 | .00 | .00 | .00 | .00 | .00 | 26.86 | .00 | .00 | .00 | 27.07 | 54.34 |
| DIESEL FUEL #2 | - | 10**3 GAL | 11.59 | 12.13 | 20.08 | 16.78 | 17.68 | 23.11 | 36.41 | 26.23 | .00 | 29.02 | 35.96 | 29.96 | 258.94 | 338.83 |
| GASOLINE | - | 10**3 GAL | 7.70 | 6.80 | 9.22 | 9.02 | 8.87 | 9.88 | 11.30 | 11.06 | 13.26 | 12.69 | 13.50 | 12.71 | 126.01 | 213.13 |
| PROPANE | - | 10**3 GAL | 28.81 | 33.17 | 37.52 | 39.57 | 8.77 | 1.52 | .00 | 1.77 | 1.75 | 4.11 | 6.93 | 12.85 | 176.79 | 216.28 |
| NATURAL GAS | - | 10**3 MCF | 36.37 | 34.80 | 38.27 | 36.34 | 40.03 | 35.34 | 36.07 | 36.68 | 39.57 | 27.39 | 20.20 | 19.19 | 400.25 | 721.01 |
| DUST PALLIATIVE | - | 10**3 GAL | .00 | .00 | .00 | .00 | .00 | 1.50 | 4.00 | 1.20 | .00 | 2.50 | .00 | .00 | 9.20 | 19.97 |
| MINED SHALE | - | 10**3 CU YD | 5.97 | 8.27 | 10.52 | 4.76 | 2.39 | .39 | 1.84 | 2.91 | 2.61 | .00 | .00 | .00 | 39.67 | 114.67 |
| MINED SHAFT ROCK | - | 10**3 CU YD | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | | 11.40 |
| EXPLOSIVES | - | 10**3 LBS | 16.75 | 21.90 | 15.07 | 18.22 | 1.47 | 2.57 | 3.54 | 9.92 | 8.40 | .72 | .00 | .00 | 98.57 | 327.02 |
| EXPLOSIVES FREQ. | - | 10**3 | .09 | .11 | .09 | .09 | .01 | .02 | .03 | .05 | .05 | .00 | .00 | .00 | .55 | 1.52 |
| DISTURBED ACREAGE | - | ACRES | 168.00 | 168.00 | 168.00 | 172.00 | 172.00 | 172.00 | 187.00 | 188.00 | 188.00 | 188.00 | 188.00 | 188.00 | | 188.00 |
| FLOCCULANT | - | 10**3 GAL | .12 | .11 | .12 | .12 | .15 | .12 | .13 | .12 | .12 | .13 | .11 | .06 | 1.43 | 1.43 |

### 4.4.1 Production Shaft

Sinking in the 29-foot-diameter shaft progressed from a depth of 1,606 feet (elevation 5,223) at year-end 1980 to the final depth of 1,867 feet (elevation 4,962) by the end of September. Excavation and concrete lining of the Lower Void Level were finished in March.

At the Lower Void Level, construction of the loading pocket area where mined material would be collected for transport to the surface was initiated. A 65-foot high concrete wall was erected, and loading pocket steel was installed. This included ore measuring flasks and lining, surge bins and rails, and other miscellaneous steel. By year's end the Lower Void Level station steel installation was nearly completed, and the galloway was made ready for movement up the shaft.

### 4.4.2 Service Shaft

The 34-foot-diameter Service Shaft reached a terminal depth of 1,765 feet (elevation 5,064) below the collar, 243 feet below the end-of-1980 level. The final blast took place April 30, 1981 two months after excavation and concrete placement on the Lower Void Level were completed. Shaft-guide steel installation then began at the man-loading floor (at the sub-collar level) and progressed down the shaft. See Figure 4-35. By September steel installation was completed, cheeseweights and the main cage counterweight were lowered down the shaft, and the galloway, hoist/guide ropes, and the sheave deck were removed. Water make at the end of the year for both the Production and Service Shafts was 761 gpm with a yearly average of 718 gpm; corresponding values in 1980 were 611 gpm and 391 gpm, respectively.

### 4.4.3 Ventilation/Escape Shaft

Shaft sinking for the 15-foot-diameter Ventilation/Escape Shaft progressed from a 1,302 foot level at year-end 1980 and attained a terminal depth of 1,617 feet (elevation 5,088) in July. This included station excavation and concrete placement at the Upper, Intermediate, and Lower Void Levels. On September 2, 1981, shaft flooding commenced as a temporary measure to reduce discharge requirements from the holding ponds. The shaft area was secured and by year's end the water elevation was 6,297 feet, 426 feet below the collar. Figure 4-36 shows an elevation view of the V/E Shaft illustrating all the level stations and the water level in the flooded shaft.

### 4.4.4 Production/Service Shaft Station Development

Stations on all levels were completed to interconnect the Production and Service Shafts. The majority of the drifting was 20-feet high and 30-feet wide with smaller drifts for sumps and water collection areas. These stations are as follows:

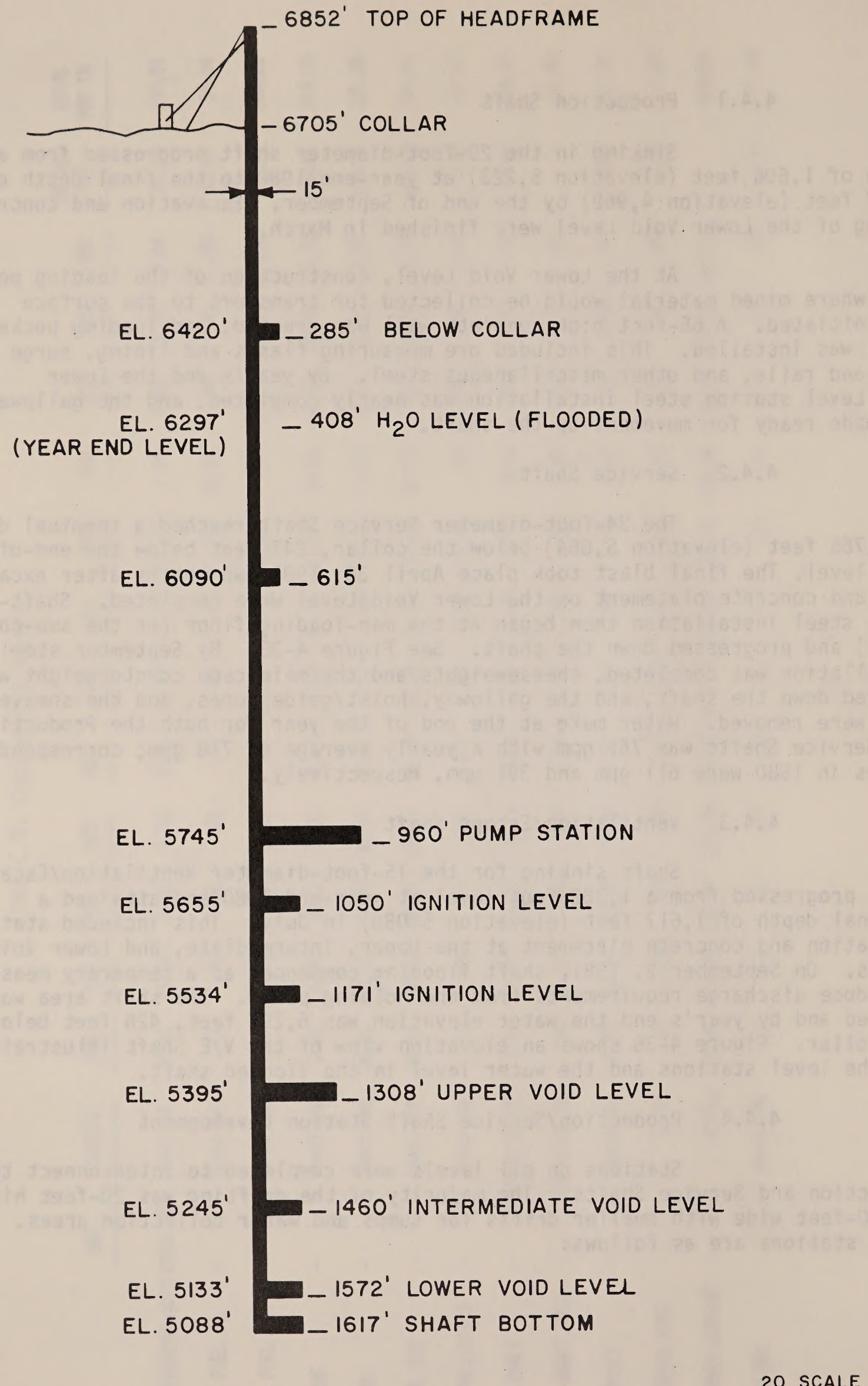



Figure 4-36
Cross-section view of the ventilation/escape shaft

Collar Level (6,829-feet elevation)
Midshaft Level (6,095-feet elevation)
Ignition Level (5,647-feet elevation)
Upper Void Level (5,481-feet elevation)
Intermediate Void Level (5,345-feet elevation)
Lower Void Level (5,208-feet elevation)
Bottom Level (4,966-feet elevation) (Production Shaft drift only)

These stations are shown on the isometric sketch on Figure 4-37 which highlights the shaft dewatering pumping system. Briefly, 58 hp Flygt pumps are utilized to pump water from the sump at the shaft bottom of the Production Shaft up to the sump at Lower Void Level of the Service Shaft; then two Ash C-5 pumps of 200 HP each pump the waters up and over to the sump at the Upper Void Level of the Production Shaft; from there 2 C-5's pump up to the Midshaft Station at the Midshaft Level; from there 4 C-5's and 2 C-65's (125 hp each) pump the water over to the Service Shaft, up to the collar level and over to the lower mine water treatment ponds (A/B).

### 4.4.5 Mine Ventilation

As noted in last year's report the shafts were classified as gassy by MSHA on January 2, 1980. The ventilation system has been designed to comply with gassy mine regulations and conditions and is shown on Figure 4-38. Gas monitoring is discussed in Section 7.7.4 and in Volume 2.

The Service Shaft is equipped with a 75 hp blower fan plus propane air intake heater at the surface. At the Intermediate Void Level on the Service Shaft a 100 hp suction fan connected to a 36-inch ventilation tube moves the air from the bottom of the Service Shaft and exhausts it up the Production Shaft. Also at the Intermediate Level in the Production Shaft a 100 hp suction fan connected to a 36-in ventilation tube moves air from the bottom of the Production Shaft and exhausts it up that shaft.

As the V/E Shaft filled with water, the shaft collar was sealed with foam. A high methane reading of 7.9% was recorded and the shaft area declared "off limits". It then decided that down-shaft ventilation would be reestablished. The foam seal around the collar was removed and 50 hp fans are now in operation. Methane readings have since been approximately zero.

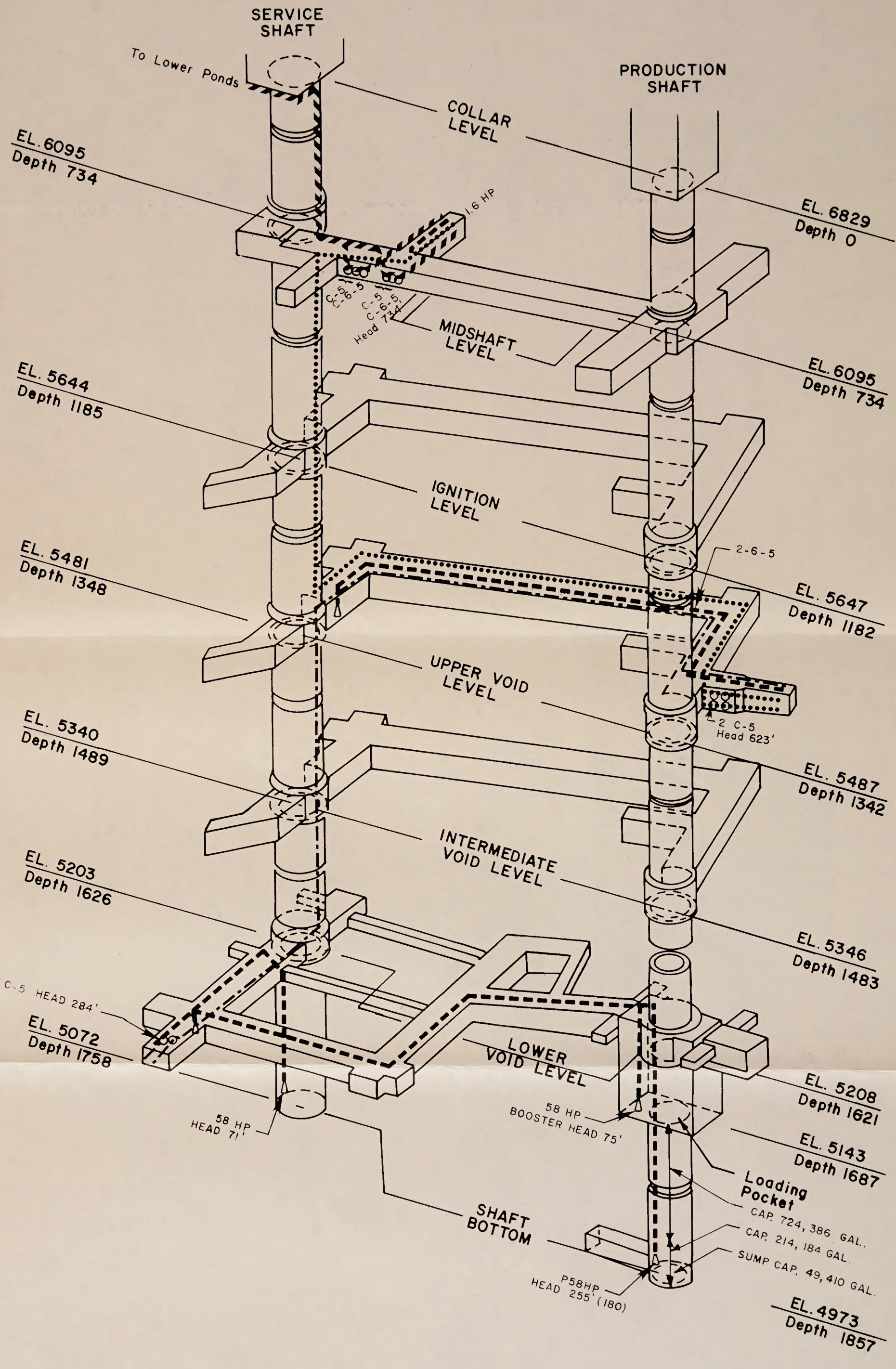
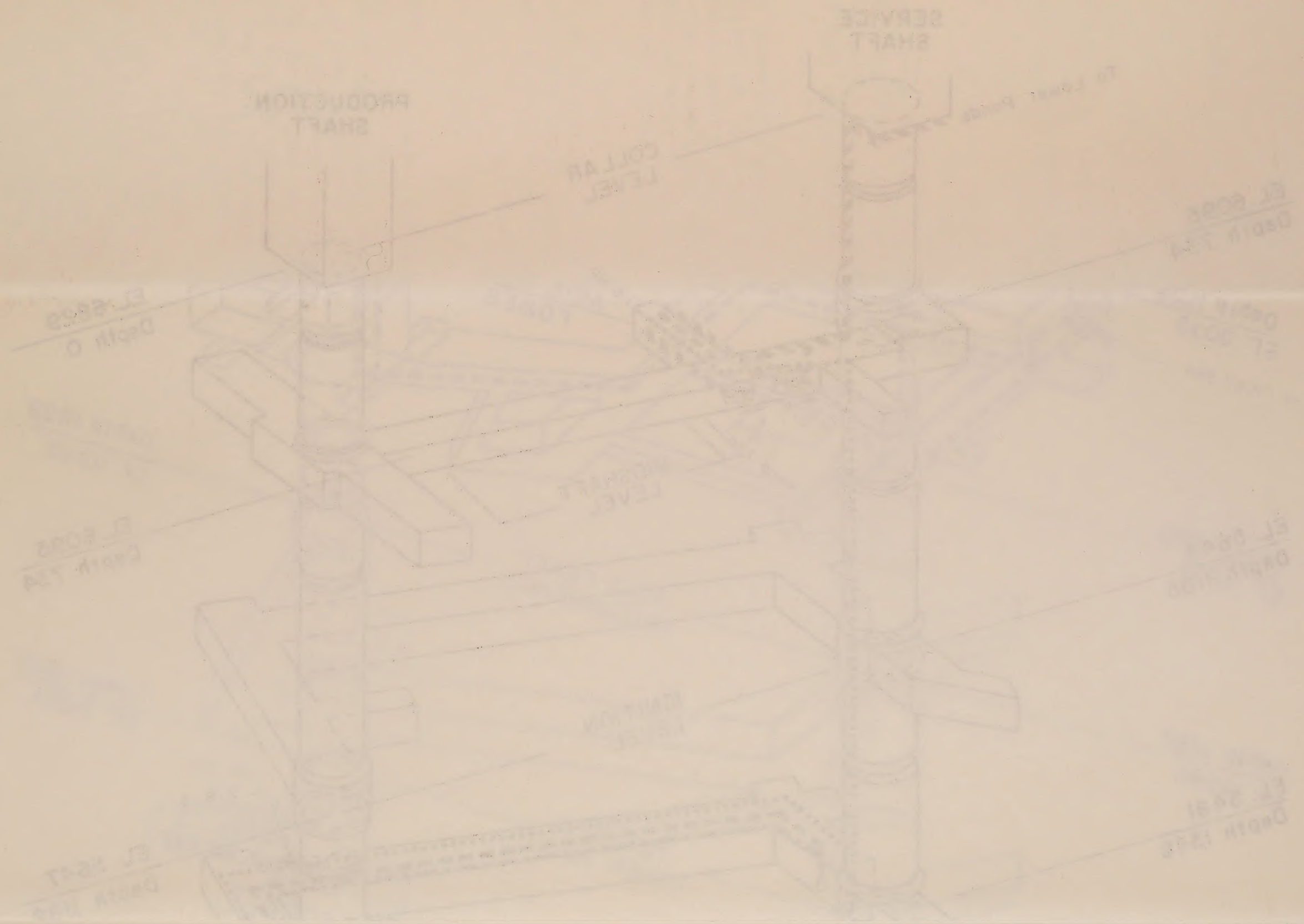



Figure 4-37
The production and service shaft station development illustrating the dewatering pumping system.



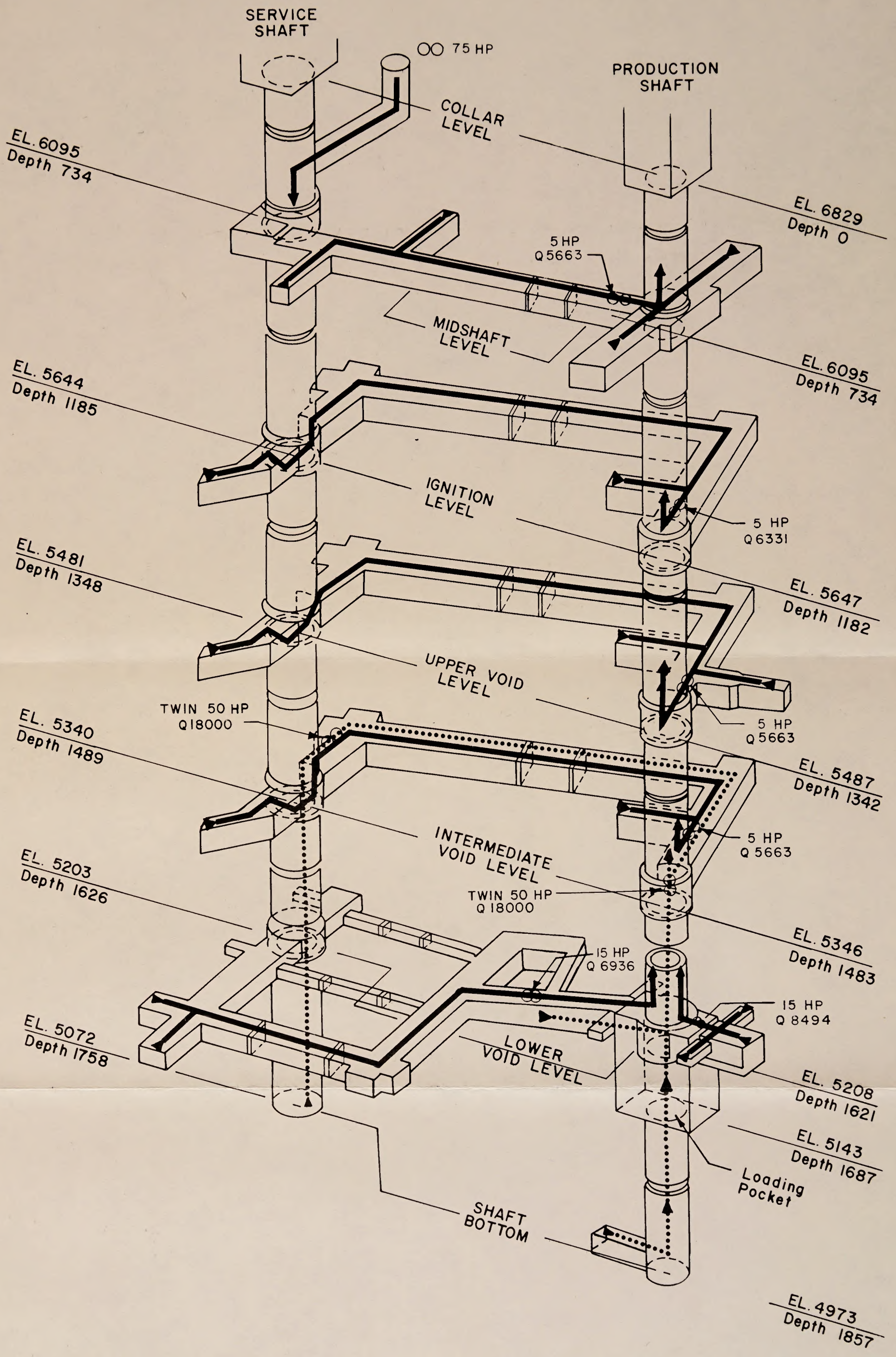
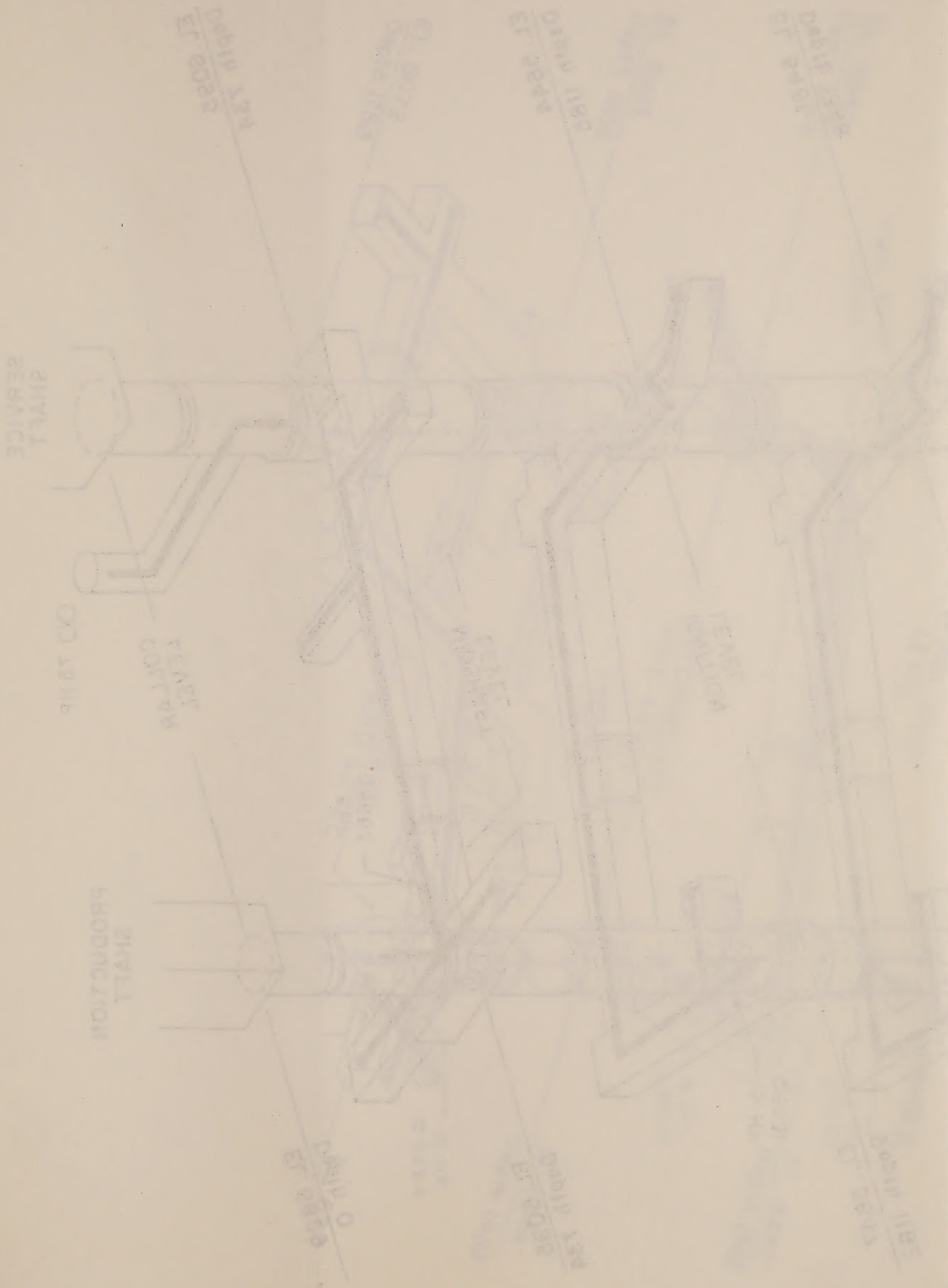



Figure 4-38
The ventilation system in the production and service shafts



# 5.0 PROCESSING

No shale oil processing facilities exist on the C-b Tract. Engineering studies related to processing are discussed in Section 4.1.12.

Approximately 50 tons of raw shale were transported to Union's retorting facility in California for a planned retorting test in 1982.

## 6.0 DISTURBED AND RECLAIMED AREAS

Areas of disturbance thru 1981 and the corresponding acreages are listed in Table 6-1 and shown on Figure 6-1 (jacket map).

### 6.1 Disturbed and Reclaimed Areas

The number of acres disturbed during 1981 was 24 bringing the total to date to 188 acres (less than 4% of the Tract). The areas disturbed in 1981 are associated with the fill material area - to be used for temporary facilities (12 acres), additional topsoil storage area (5 acres), reinjection well drill pads (5 acres), and corehole drill pads (1 acre).

Other areas of construction activity during 1981 are included in previously permitted and disturbed areas. These include borrow areas used for material to raise the elevation in the Mine Support Area (included in the Mine Support and Ancillary areas graded in 1978).

The number of acres reclaimed during 1981 was seven bringing the total revegetated acreage to 34. These new areas include the additional topsoil stockpile west of the Mine Support Area (3 acres) and the drill pads of two reinjection wells and three coreholes (4 acres).

### 6.2 Overburden Storage

No overburden was mined or stored during 1981.

### 6.3 Shale Storage

The raw shale was backfilled into the embankment (storage pile) in Little Gardenhire Gulch. The embankment had an increase in size of one acre and approximately 30 feet increase in height in 1981. The total amount of raw shale which was backfilled during 1981 was 39,670 cubic yards (95,208 tons).

The total area of the storage pile is presently 12 acres, an increase of one acre over 1980. The storage pile presently contains 56,500 cubic yards of overburden and 126,221 cubic yards of raw shale.

### 6.4 Reclamation/Revegetation Status and Control

#### 6.4.1 Backfill

The backfilled area for 1981 consisted of the berm (raw shale storage pile) in Little Gardenhire Gulch (one acre). Total area backfilled is 16 acres, consisting of four acres of rock stockpile and 12 acres of raw shale embankment.

#### 6.4.2 Graded Lands

In addition to the 122 acres remaining in graded condition in 1978, 1979, and 1980, the borrow area (12 acres) and 2 acres consisting of roads to new drill pads are in graded condition. This brings the total acreage in graded condition to 136 acres. Graded conditions consist of areas that have been disturbed and are stablized through the use of at least 50% rock in the

TABLE 6-1

Disturbed and Revegetated Acreages

| Area* | Acreages Disturbed Before 1981 | Acreages Disturbed During 1981 | Total 12/31/81 | Acreages Revegetated Before 1981 | Acreages Revegetated During 1981 | Acreages Permitted But Not Disturbed |
|---|---|---|---|---|---|---|
| 1) Guard House & Truck Scale Area | 2 | | 2 | | | |
| 2) Sewage Treatment Plant & Road | 2 | | 2 | | | |
| 3) Heliport & PR Trailer | 1 | | 1 | | | |
| 4) Main Access Road | 24 | | 24 | | | |
| 5) V/E Shaft Area | 14 | | 14 | | | |
| 6) Proposed Dam Site (Little Gardenhire) | 3 | | 3 | 3 | | |
| 7) Fill Material Area | | 12 | 12 | | | |
| 8) Explosives Storage | 2 | | 2 | | | |
| 9) Mine Support | 73 | | 73 | | | |
| 10) Raw Shale Embankment | 11 | 1 | 12 | | | |
| 11) Rock Stockpiles | 4 | | 4 | | | |
| 12) Topsoil Stockpiles | 8 | 5 | 13 | 8 | 3 | 10 |
| 13) Water Discharge & Application Area | 4 | | 4 | | | 2 |
| 14) Abandoned Access Road | 10 | | 10 | 10 | | |
| 15) Process Facility | | | | | | 74 |
| 16) Water Treating Facility | | | | | | 5 |
| 17) Cut Bank Material Area | | | | | | 12 |
| 18) Pond "C" Pipelines | 2 | | 2 | 2 | | |
| 19) Irrigation Pipeline | 4 | | 4 | 4 | | |
| 20) Reinjection Pipeline | | | | | | 14 |
| 21) Pond "D" | | | | | | 3 |
| 22) Injection Station | | | | | | 1 |
| 23) Drill Pads & Roads** | | 6 | 6 | | 4 | 11 |
| TOTALS*** | 164 | 24 | 188 | 27 | 7 | 132 |

*Numerated Areas in column correspond to numerated areas on "C.B. Tract Disturbed Areas Map" #AD-0039 Rev.3, January, 1982, Figure 6-1 (Jacket Map)

**Drill pads for additional core sampling and reinjection well in 1981 and thereafter.

***Total acreage disturbed to date = 188
Total acreage revegetated to date = 34
Total acreage permitted for disturbance but not yet disturbed = 132

soil surface and are now mechanically stablized through the use of dust palliatives and water.

### 6.4.3 Topsoil Replacement

Topsoil was replaced on drill pads of two reinjection wells and three coreholes (4 acres). Total acreage revegetated to date is 34 acres.

### 6.4.4 Revegetation

The areas revegetated in 1981 are the additional topsoil stockpile west of the Mine Support Area (3 acres) and the drill pads of two reinjection wells and three coreholes (4 acres). Total acreage revegetated to date is 34 acres.

## 6.5 Overburden and Topsoil Management

### 6.5.1 Vegetation Plantings/Mixtures

The topsoil pile west of the Mine Support Area was seeded in October, 1981. The drill pads (four) were seeded in early November, 1981.

Both areas were seeded with the permanent seed mixture (Table 6-2).

No fertilizer was applied during 1981.

The revegetated areas evaluated during 1981 include (among others) the ones seeded in 1978 (topsoil stockpiles south and west of the Mine Support Area -- shown as the most southerly Area #12 on Figure 6-1). See Figures 6-2, 6-3, and 6-4 for typical revegetation projects in 1979, 1980, 1981. Total mean cover in 1981 in the herb layer was 19.9 percent and bare soil 18.3 percent. The mean number of species per square meter was 6.68 $\pm$ 0.35. Mean total production was 113.76 g/m$^2$. The most prevalent species were wheatgrasses (Agropyron spp.), Utah sweetvetch (Hedysarum boreale), sweetclover (Melilotus spp.), Russian thistle (Salsea iberia), and Kochia (Kochia iranica). The results of the evaluation of the revegetated areas are presented in Volume 2A of this Annual Report.

### 6.5.2 Associated Costs

The total costs associated with reclamation and revegetation amounted to approximately $5,900 for 1981. The breakdown of approximate costs are as follows: seed and transplants, $2,000; equipment rental, $1,000; mulch, $1,200; fence, $500; labor, $1,200.

TABLE 6-2

Species List for C.B. Reclamation

| Species | | Lbs/Acre Drilled North & East and Level Areas | Lbs/Acre Drilled South & West Areas |
|---|---|---|---|
| Grasses: | | | |
| *Agrophyron cristatum | - crested wheatgrass | 1 | 1 |
| *A. elongatum | - tall wheatgrass | - | 1 |
| *A. spicatum var. inerme | - beardless bluebunch wheatgrass | 2 | 2 |
| *A. smithii (rosana) | - western wheatgrass | 1 | 2 |
| *A. intermedium (amur) | - intermediate wheatgrass | 1 | 2 |
| *Bromus marginatus | - mountain brome | 1 | - |
| *Elymus cinereus | - Great Basin wildrye | 1 | - |
| *E. junceus | - Russian wildrye | 1 | 1/2 |
| *Festuca ovina | - hard sheep fescue | 1 | - |
| *Oryzopsis hymenoides | - Indian ricegrass | - | 1 |
| Forbs: | | | |
| *Hedysarum boreale (Utah) | - Utah sweetvetch | 1/2 | 1/2 |
| *Medicago sativa | - alfalfa | 1 | 1/2 |
| *Penstemon sp. | - penstemon | 1/2 | 1/2 |
| Shrubs: | | | |
| *Amelanchier spp. | - service berry | - | - |
| *+Artemisia tridentata | - big sagebrush | 1/2 | - |
| *Atriplex canescens | - four wing saltbrush | - | 2 |
| *A. confertifolia | - shadscale | - | 1 |
| *+Cercocarpus montanus | - moutain mahogany | 1 | 1/2 |
| *Cowania mexicana | - stansberry cliffrose | 1 | 1/2 |
| *Eurotia lanata | - winterfat | - | 1 |
| *+Purshia tridentata | - bitterbrush | 1 | 1/2 |
| +Symphoricarpos oreophilus | - snowberry | | |
| Trees: | | | |
| +Juniperus osteosperma | - Utah juniper | | |
| +J. scopulorum | - Rocky Mountain juniper | | |
| +Pinus edulis | - pinyon pine | | |
| TOTAL | | 13 1/2 | 15 1/2 |

*Seed (P.L.S. - Pure Live Seed)
+Transplants (40 per acre) will be placed selectively in areas of suitability; (North, East and level areas), transplants will total 320 per acre.

Note: Forb seed will be innoculated with Northrup King innoculator.

Figure 6-2. Revegetation progress on south topsoil pile - 1979. Seeded in 1978. View from southeast corner.

Figure 6-3. Revegetation progress on south topsoil pile - 1980.

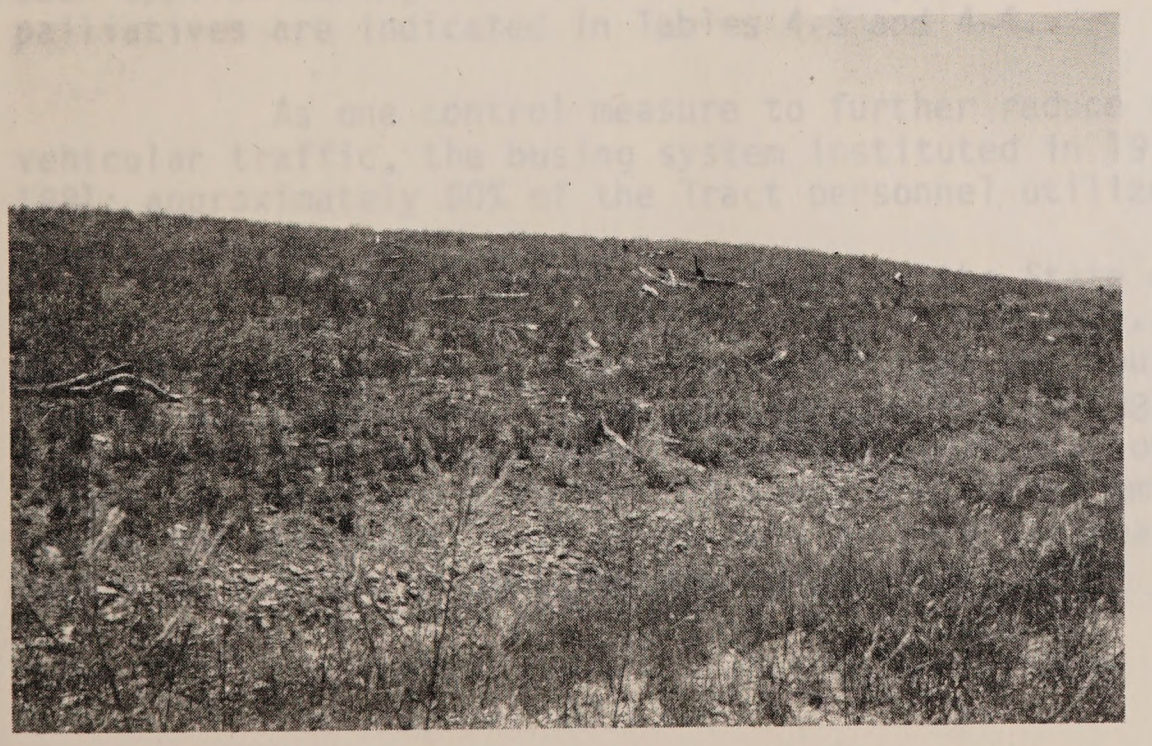


Figure 6-4. Revegetation progress on south topsoil pile - 1981.

# 7.0 ENVIRONMENTAL PROTECTION AND CONTROL

## 7.1 Air Pollution Control and Visibility

Principle activities in 1981 with the potential to affect air quality included the continued sinking of the Production, Service, and V/E Shafts, truck transport along haul roads, operation of the cement batch plant, operation of the feeder breaker, continued construction in the Mine Support Area, operation of the temporary power generators, and permitted open burning.

Comparisons of air monitoring and measurements with ambient air quality standards are made in Volume 2 of this Annual Report; compliance with these standards was achieved in 1981. See Figure 7-1 for a picture of the newly installed air quality station AB26.

Air pollution permit conditions require use of control equipment and operating procedures. Permit status is summarized in Section 7.11 in tabular form showing permit purpose, agency, permit number and approval date.

C.B. holds a valid Prevention-of-Significant-Deterioration (PSD) Permit for the Ancillary Phase of MIS operations (defined in 1977 as up to 5,000 barrels/day nominally) from the EPA.

Baghouses on the cement batch plant were previously described in the 1979 Annual Report; these represent the only point-source controls required at present. Emissions from temporary power generators require emission source permits; controls are not required, since they are below the horsepower level requiring controls.

The C.B. project obtained a Fugitive Dust Permit (C-11, 454 (FD) from the Colorado Air Pollution Control Division in 1977, revised in 1980. Pursuant to this permit, C.B. paved the major access road to the Tract. This work was completed in August of 1978. PSD and Fugitive Dust Permits require dust control on haul roads by regular applications of water and dust palliatives. The PSD Permit requires quarterly reports to the EPA regarding both total water used and the amount and type of dust palliative applied. Water has been applied to the haul roads on an as-needed basis; dust palliatives have been applied during 1980 and 1981. The applications of both water and dust palliatives are indicated in Tables 4-3 and 4-4.

As one control measure to further reduce road dust by reducing vehicular traffic, the busing system instituted in 1978 continued to be used in 1981; approximately 60% of the Tract personnel utilized the buses in 1981.

In 1981 a permit was issued by the State of Colorado for a feeder-breaker to crush oil shale rock to minus 8 inch size. See Figure 7-2. Maximum throughput is limited to less then 1,000 tons per hour and annual throughput is limited to 70,000 tons. Total tonnage crushed in 1981 was approximately 550. Water spray bars are utilized as the approved emission control devices. No permit was necessary from the EPA since the annual emission level does not exceed the diminimus level of 25 tons of dust per year based on an emission factor of 0.1 lbs of dust per one ton of rock.

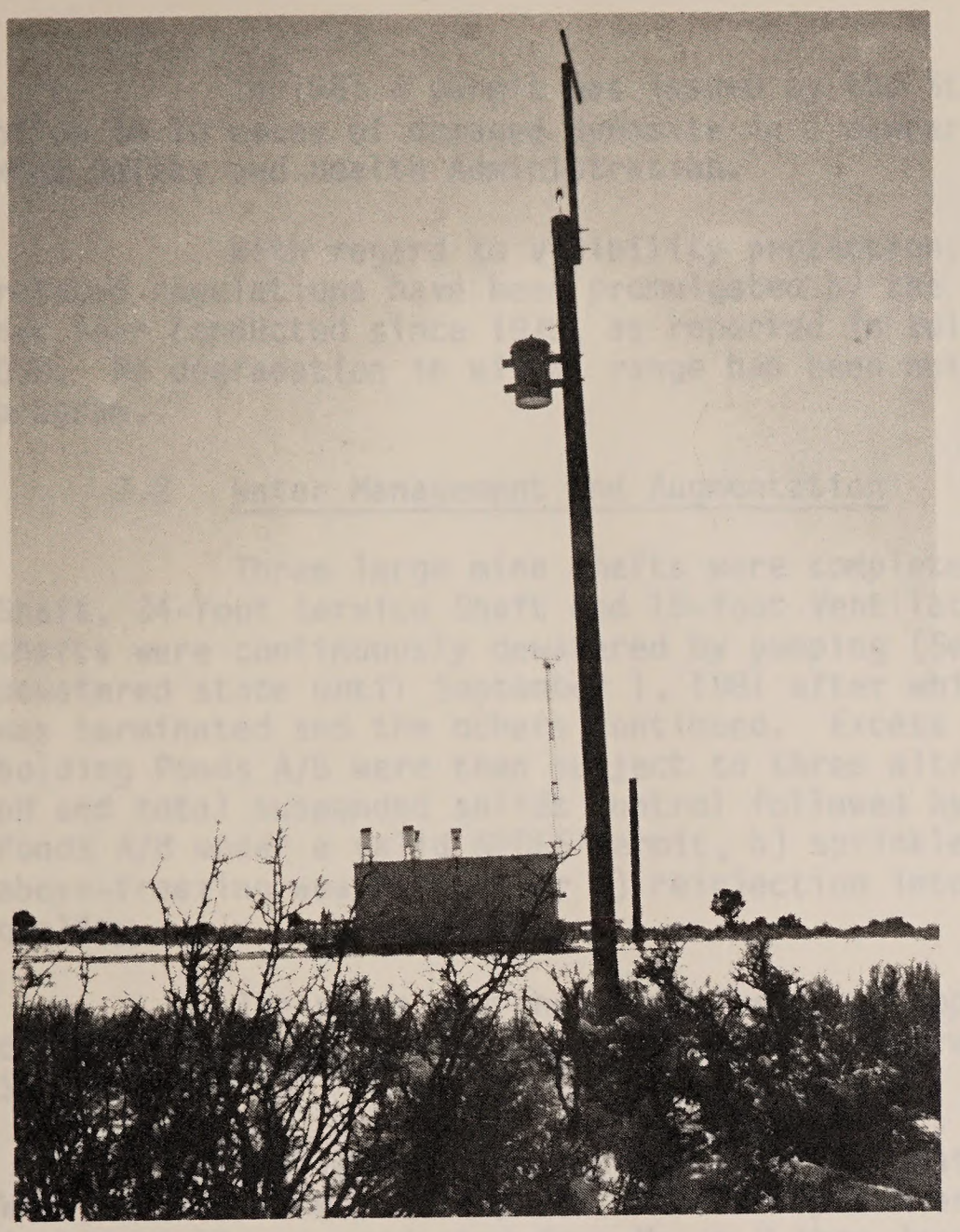


Figure 7-1. Newly completed air quality station AB26 showing the completed power line. (January 1981)

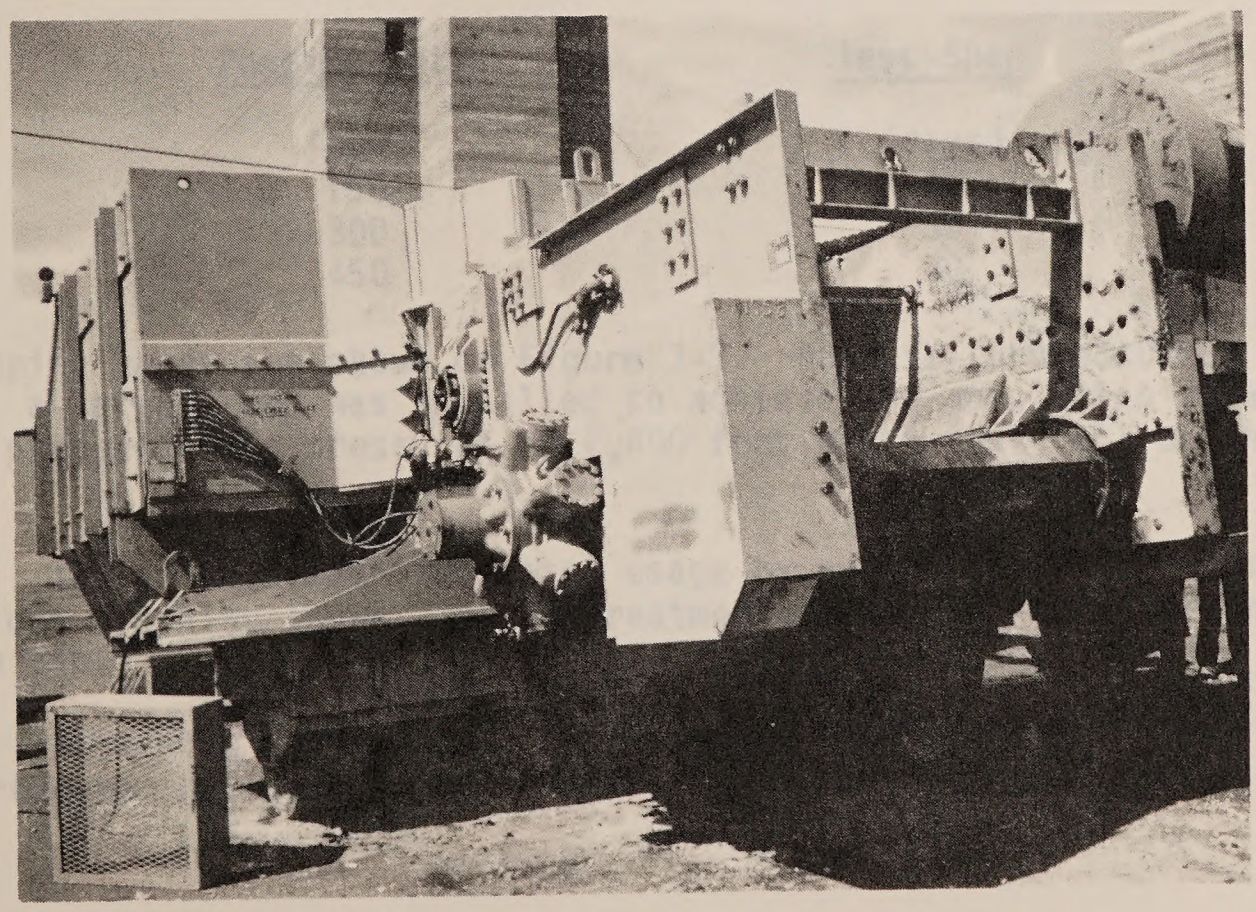


Figure 7-2. Portable feeder breaker (rock crusher). (March 1981)

In 1981 a permit was issued by the State for open burning disposal of up to 10 cases of damaged dynamite in a manner of disposal acceptable to the Mine Safety and Health Administration.

With regard to visibility protection; no specific visibility - related regulations have been promulgated by the EPA. Visibility monitoring has been conducted since 1975, as reported in Volume 2, under request of the OSO. No degradation in visual range has been noted since the inception of this program.

## 7.2 Water Management and Augmentation

Three large mine shafts were completed in 1981: 29-foot Production Shaft, 34-foot Service Shaft and 15-foot Ventilation/Escape (V/E) Shaft. These shafts were continuously dewatered by pumping (Section 4.4.4) to retain a dewatered state until September 1, 1981 after which pumping of the V/E Shaft was terminated and the others continued. Excess mine waters as pumped to holding Ponds A/B were then subject to three alternative modes of treatment: a) pH and total suspended solids control followed by subsequent discharge from Ponds A/B under a valid NPDES permit, b) sprinkler irrigation on Tract during above-freezing weather and/or c) reinjection into groundwaters of similar water quality.

The ponds and the sprinkler (land application) systems were described in the 1980 Annual Report (e.g. see Figure 4-25a, Water Management System Layout).

The reinjection test well is designated 11X-18 (computer coded WI18) and is shown near Pond C as facility number 65 on Figure 4-4. A reinjection test was conducted from March 2 thru June 20, 1981. Test protocol was planned as follows:

| Pumping Rates | Test Span |
|---|---|
| (gpm) | (days) |
| 150 | 30 |
| 300 | 30 |
| 450 | 30 |

Actual pumping rates are shown on Figure 7-3. Pump failure occurred at the 300 gpm level; a larger pump was installed to achieve 450 gpm. Also shown are well head pressures and pressures at 1,400 foot depth (psi) all on the same scale.

Table 4-3 summarizes water usage by month; annual and cummulative annual values are also shown. Water treatment rates (gpm) are further summarized on Table 7-1.

Regarding compliance with the NPDES permit in 1981, high values were reported to the State as follows:

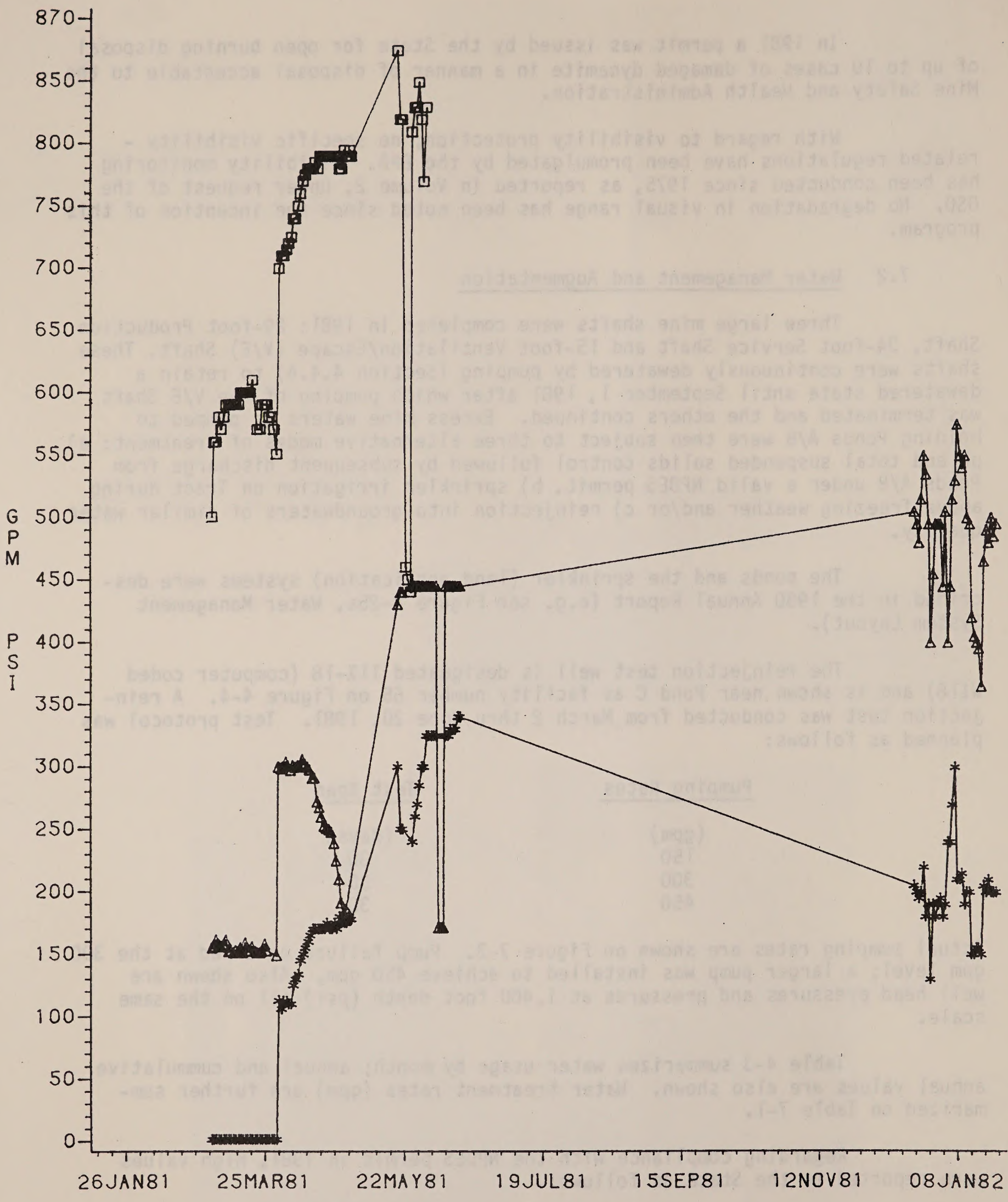



FIGURE 7-3 C.B. Reinjection Test Parameters

TABLE 7-1

Summary of Water Management (gpm)

| Month | Total Water Pumped | Water Used, Stored, Evaporated | Water Treated | | | |
|---|---|---|---|---|---|---|
| | | | NPDES Discharges | Sprinkler (Land Application) | Reinjection | Total |
| January | 1,645 | 341 | 1,304 | - | - | 1,304 |
| February | 1,663 | 596 | 1,067 | - | - | 1,067 |
| March | 1,392 | 498 | 754 | - | 140 | 894 |
| April | 1,122 | 278 | 583 | - | 261 | 844 |
| May | 1,636 | 466 | 1,109 | - | 61 | 1,170 |
| June | 1,221 | 136 | 745 | 48 | 292 | 1,085 |
| July | 1,582 | 467 | 739 | 339 | 37 | 1,115 |
| August | 1,550 | 275 | 942 | 326 | 7 | 1,275 |
| September | 617* | 180 | 293 | 39 | 105 | 437 |
| October | 627 | 184 | 8 | - | 435 | 443 |
| November | 660 | 205 | 16 | - | 439 | 455 |
| December | 772 | 298 | - | - | 474 | 474 |

*Starting September 1, 1981 V/E Shaft no longer pumped.

| Parameter | No. of High Values |
|---|---|
| Fluoride | 42 |
| Total Suspended Solids | 1 |
| pH | 1 |

It is to be noted that pond waters are treated for suspended solids by settling enhanced by baffles and addition of flocculant and for high pH by addition of sulfuric acid; fluoride is not treated. The high values for fluoride are not exceedances since there is no enforceable fluoride standard in the State of Colorado. The proposed fluoride standard in our permit application (i.e., C.B. has contested State proposed fluoride criteria and proposed other criteria) is subject to a request for an adjudicatory hearing. Further, as previously stated, the V/E Shaft has been allowed to flood as of September 1, 1981. As a result of cessation of dewatering of V/E Shaft, further discharges from the ponds to State waters may not be required. Reinjection is the proposed management mode to be followed, consistent with zero discharge goals.

Close contact with the State Water Quality Control Division is maintained regarding progress on NPDES permit processing and in-stream classification of Piceance Creek; as yet, it is unclassified.

Planning on water storage projects has proceeded along two lines:

1) Yellow Jacket Study - this study has been funded by the State of Colorado and is restricted to selection of storage sites on the White River or its tributaries above the confluence with Piceance Creek.

2) White River Study - this plan is a joint effort between industry and the State's Yellow Jacket plan. Work includes evaluation of alternatives and delivery systems to cover Piceance Basin oil shale projects in the study.

Highlights of the C.B. Water Augmentation Plan were given in the 1980 report. To the present time no water augmentation by C.B. for Piceance Basin users has been required by the State Engineer or needed.

## 7.3 Oil and Hazardous Materials and Associated Spill Contingency

The Spill Prevention Control and Countermeasure Plan includes a description of the potential for accidental spills or release of oil and other hazardous materials as a result of the Lessee's development of the Tract and associated off-Tract pipelines and terminals. This plan summarizes the potential source of accidental spills, reviews the current regulations and standards that would apply to the Lessee's activities, defines and inventories the hazardous materials within the plant, and presents the Lessee's spill prevention, control, and contingency plans for the plant and associated pipelines. The Plan will be updated in 1982.

### 7.3.1 Summary of Potential and Actual Spills During Construction

During construction activities, spills of diesel fuels and other fuels and lubricants are possible during transportation, loading, and

unloading operations, both on-Tract and at construction staging areas and rail spurs. Dust suppressants and smaller amounts of miscellaneous chemicals used during construction activities also pose pollution threats if quantities of these materials reach drainages or flowing streams near the Tract. The trucking, loading, and unloading of fuels and chemicals during construction is a potential source of accidental spills. A program has been initiated to insure that all transformers brought on Tract will not contain PCB's.

There were no reportable spills (see 7.3.3) requiring activities of the spill contingency plan during the year. There were five minor spills involving gasoline and diesel fuel on or near the Tract in 1981. All of the spills were contained immediately and cleaned up, thereby presenting no danger to personnel or the environment. The cleanup procedure consisted of covering the spills with sand to soak up the fuel. New soil was then put in place and the contaminated soil was removed and disposed in the Rifle landfill with other solid wastes.

### 7.3.2 Oil and Hazardous Materials Inventory

A list of substances expected to be present in substantial quantities within the shale oil plant for commercial operations is presented on Table 7-2 and compared with that existing in 1981. The list identifies those both on and off-Tract which would be classed as pollutants if allowed to escape; locations are cross-referenced to maps in this report. With regard to oily sludge, it is anticipated that it will be produced in small enough quantities that no storage need be provided and that it is of such nature that it can be cycled into conceptual surface retorting facilities.

### 7.3.3 Notification Under the Response Plan

In the event of an accidental spill of oil or hazardous material in quantities greater than those specified by the regulations, various governmental entities must be notified. Spills consisting solely of oil are reportable when they reach or have the potential of reaching a waterway in quantities which cause a film, sheen or discoloration of the water. Spills involving hazardous materials are reportable when they occur on the land or reach a waterway in quantities exceeding those specified by the regulations.

| Notification | Spills Situation |
|---|---|
| National Response Center (NRC) | "Reportable Spills" |
| Regional Response Center | When the NRC cannot be contacted |
| Colorado Department of Health | "Reportable Spills" |
| Colorado Division of Wildlife | Danger to fish, etc., in surface water supplies |
| Water Quality Control Division, Colorado Department of Health | Contamination of water supplies |
| Colorado Highway Department | Move vehicles, control traffic |
| OSO | All spills |
| BLM, USFS | Certain cases |
| Local, city, fire, police, health departments | Major spills |

TABLE 7-2

Oil and Hazardous Materials Inventory

| Material Stored | Commercial Operations Storage Capacity BBL | Storage Site No.** | 1979 Storage BBL | 1980 Storage BBL | 1981 Storage BBL |
|---|---|---|---|---|---|
| On-Tract | | | | | |
| Process Retort Water Stripper Feed | 60,000 | - | 0 | 0 | 0 |
| Process Condensate Water Stripper Feed | 80,000 | - | 0 | 0 | 0 |
| Plasticrete | 100 | 15 | 50 | 50 | 90 |
| Diesel Fuel | 4,000 | 16 | 830 | 2,950 | 3,000 |
| Gasoline | 1,000 | 16 | 35 | 645 | 1,000 |
| Motor Oil and Grease | 70 | * | 0 | 0 | 70 |
| Chlorine | 50 | 15 | 10 | 10 | 0 |
| Oil-Water Separator Liquid | 1,000 | - | 0 | 0 | 0 |
| LPG | 1,000 | * | 190 | 850 | 837 |
| Ammonia | 13,000 | - | 0 | 0 | 0 |
| Shale Oil | 350,000 | 40 | 0 | 0 | 244 |
| Sulfuric Acid | 100 | 43 | 30 | 100 | 100 |
| Off-Tract | | | | | |
| Ammonia | 1,500 | - | 0 | 0 | 0 |

*Stored at numerous locations on construction site.
**See Figures 4-2 and 4-3.

### 7.3.4 Spill Response Team

All spills not involving the product oil pipeline will be responded to by an in-plant spill response team which will be especially organized and trained for this purpose. A Spill Response Coordinator (SRC) has the primary responsibility for deciding the action required and assembling the necessary team elements.

The following is a list of Spill Response Team Members:

| | |
|---|---|
| Spill Response Coordinator | J. P. Reynolds |
| Cleanup Coordinator | S. L. Stringer |
| Government Liaison Coordinator | E. B. Baker |
| Public Relations Coordinator | M. D. Talbert |
| Legal Coordinator | D. R. Hale |
| Environmental Protection Coordinator | E. B. Baker |
| Procurement and Logistics Coordinator | G. Jay |
| Document Coordinator | T. H. Pysto |
| Accounting Coordinator | L. G. Barth |
| Training Coordinator | J. A. Fox |
| Safety and Security Coordinator | D. I. McClung |

## 7.4 Waste Disposal

A 9,000 gallon-per-day Sewage Treatment Facility was placed in operation in March, 1981. Sewage sludge and gray water (approximately 35,000 gallon/week) were hauled to this treatment plant. Solid waste (trash) accumulated in waste bins was trucked off-site as frequently as necessary to approved land fills in Rifle; total amount for 1981 was 6,070 cubic yards.

## 7.5 Erosion Control

The six sediment basins on C-b were cleaned and maintained in 1981. An additional sediment basin was built in the Brown & Root bank and material area (See 1981 Disturbance Map - Figure 6-1).

## 7.6 Historic, Scientific, and Aesthetic Values Protection

As part of the Lessee's plan to protect these assets, archaeological and scenic-value studies have been undertaken on the Tract and surrounding area and reported in prior years; no new studies were conducted or needed for areas disturbed in 1981. During construction no significant findings have occurred.

Where possible, disturbance is minimized. All stockpiles are contoured and seeded to blend with surrounding habitat.

## 7.7 Health, Safety and Security

### 7.7.1 Program and Services

#### 7.7.1.1 General

All levels of the C.B. management have a complete commitment to employee protection. Various contractors conduct regular safety meetings for their employees with the active participation of the C.B. Safety Department. New employees are required to receive health and safety training prior to being assigned work duties.

On site (1981), C.B. had a Health/Safety/Security Supervisor, two safety inspectors, a Security Supervisor, ten Security Guards, and one secretary. Two major contractors also have a full-time safety personnel.

The Health Department consists of a Grand Junction based Industrial Hygienist and an Industrial Health Coordinator who spends 25% of her time at the C-b Tract.

Emergency medical service is provided twenty-four hours a day by one paramedic and eleven emergency medical technicians (EMT's). A fully equipped ambulance is available for off-site and C-b Tract emergency medical treatment. An ongoing EMT training program has been established with the assistance of Occidental physician advisors for the emergency medical personnel on the C.B. jobsite. Part of the EMT/paramedic training program consists of monthly training sessions with demonstrations and shaft extrication classes.

An EMT coordinator was selected and is monitoring the First Aid Trailer, ambulance, all medical supplies and equipment and assisting with the EMT training.

St. Mary's Air Helicopter is available for extreme medical emergencies twenty-four hours a day. C.B. operated a Long Ranger Helicopter in 1981, which was available for backup emergency medical transporation.

The C.B. Security Manual was completed during 1980. The C.B. Safety Manual was completed during 1981. The C.B. Industrial Hygiene Manual work was suspended in 1981 until final selection of retorting technology is made for both underground and surface retorting.

Industrial hygiene research at Occidental's Logan Wash oil shale facility began in 1981. One of the primary purposes of the industrial hygiene activities at Logan Wash is to provide input to properly design and implement an industrial hygiene program for the C.B. project.

#### 7.7.1.2 Manhours/Accident Frequency Rate

Following are figures depicting the manhours and accident frequency rate for the year 1981 at the C-b Tract:

| | Manhours | Reportable Accidents YTD | Lost Time Accidents YTD | Incident* Rate YTD |
|---|---|---|---|---|
| C.B. | 231,020 | 1 | 1 | 0.9 |
| Contractors | 734,616 | 35 | 21 | 9.53 |
| TOTAL | 956,636 | 36 | 22 | 7.53 |

*IR = Incident Rate = $\frac{\text{Number of Reportable Accidents x 200,000}}{\text{Hours of Employee Exposure}}$

The incident rates for 1979 and 1980 were 1.90 and 5.10 respectively for C.B. and contractors combined.

#### 7.7.1.3 Inspections and Violations

Cathedral Bluffs had a total of 72 inspection days during the year 1981. The following is a list of the number of citations which Occidental and its contractors received during the year 1981:

| Company | Number of Citations | Abated/Terminated |
|---|---|---|
| C.B. | 50 | 44 |
| Contractors: (Gilbert, T.I.C., Brown & Root, Scott-Ortech Connors Drilling Co., Harrison) | 50 | 47 |

OSO also performs inspections for Lease and DDP compliance. Copies of inspection reports were furnished to the Project.

Colorado Division of Mines was on site four times this year resulting in the issuance of five additional citations: three citations were abated. Those citations not abated or terminated remain in the "no determination" status.

### 7.7.2 Possible Health Hazards

#### 7.7.2.1 Dust

Dust is controlled on unpaved sections of roadways by the application of dust suppressant. Dust is controlled during rock drilling operations by the use of water. Although there have been no surveys conducted yet to determine full-shift mine employee exposure to dust, it is not anticipated that problems exist in this area due to the large amount of groundwater release during mining operations. Respirators are provided for employee use when assigned to dusty areas both aboveground and in the mine.

#### 7.7.2.2 Noise Control

Occupational noise control for employee protection is accomplished where feasible by equipment design. When this approach is not feasible, or when engineering design does not reduce noise levels below the maximum allowable limit, all exposed persons are required to wear ear protection.

Monitoring of environmental noise and its compliance are discussed in Volume 2.

### 7.7.3 Fire Control

The fire control systems utilized at the C-b Tract include the following:

- Dry chemical hand-held and wheeled fire extinguishers for protecting all buildings, including hoist houses.
- A twin agent (dry chemical/water foam) trailer extinguisher for large fire protection.
- Rubber-tired water tanker trucks available for use in extinguishing brush fires that might develop on site.

Fire control training has been provided for both surface and underground situations. A mine-rescue team existed on site in 1981.

### 7.7.4 Gas

The shafts were classed as gassy on January 2, 1980 by MSHA. During most of the gas sampling program air sampling bags were utilized and the analysis was performed on site by using a Hewlett Packard Gas Chromatograph. Samples were taken on a daily basis. This particular program was suspended in August of 1981 after the planned flooding of the V/E Shaft. Gas samples have been taken at each shaft collar on a daily basis with hand- held methanometers since August. Weekly averages of samples taken at the shaft collars are reported in Volume 2.

### 7.7.5 Explosives Handling and Storage

Explosives for mining and surface construction use are stored in remotely located surface magazines (facility #71, located on Figure 4-5) which meet the criteria of the appropriate regulatory agencies. Explosives handling and transportation from magazine to the work site are conducted only by experienced, trained workers. Damaged and outdated explosives are burned in a remote location on Tract by the safety personnel under appropriate permit.

## 7.8 Fish and Wildlife Protection

### 7.8.1 Objectives

The Fish and Wildlife Protection Plan has been developed to provide procedures to avoid or minimize adverse effects on fish and wildlife caused by the development and operation of oil shale facilities on Tract C-b. The habitat management plan uses the baseline environmental data as a frame of reference. It delineates habitat losses that may occur and mitigation efforts needed either to replace in-kind or to improve alternative habitat for selected species of animals.

### 7.8.2 Estimated Access-Road Effects

It was hypothesized that the main C.B. access road might impede deer movement through the pinyon-juniper vegetation type north of the Tract. Also, it was felt that a major ecosystem impact might result from deer/vehicular collisions. These impacts have not materialized. Our studies show that the deer have not significantly altered their use patterns near the access road. See Volume 2 for details.

### 7.8.3 Mitigative Actions for 1981

#### 7.8.3.1 Brush Beating

The areas which were brush beaten in 1980 were sampled for plant productivity, species composition, and deer and lagomorph abundance. Use in the area by wildlife was light. The results of these transect studies are discussed in Volume 2.

#### 7.8.3.2 Land Application System

The land application (sprinkler) system was in operation in the summer of 1981. The main objective of the irrigation system was to provide a method of disposing of excess mining water during the summer months until such time as the water can be used for retort processing or for reinjection. The sprinkler system also seems to be a good mitigation project because the vegetation productivity is increasing due to the additional moisture. Livestock utilization also seems to have increased in the sprinkler area. Permanent transects were sampled for deer and lagomorph pellet group densities, productivity and utilization, small mammal and avifauna abundance. Results of these analyses are discussed in Volume 2.

#### 7.8.3.3 Road/Reflector Program

Cathedral Bluffs Shale Oil Co., in cooperation with various agencies including the Colorado Division of Wildlife, Oil Shale Office and Rio Blanco Oil Shale Company, is testing a new type of reflector along the Piceance Creek Highway. These post-mounted reflectors have been used successfully in Austria, but the concensus of our group is that a better controlled study is needed to fully evaluate their effectiveness. The new type of reflector refracts red light away from the road which seems to last for longer duration than the single flash from a conventional mirror reflector. The

reflectors are installed along both sides of the highway and light up progressively as a vehicle proceeds down the highway creating an optical warning fence at night.

The study design includes installing four one-mile sections of these reflectors (both sides of the road) in areas having the highest record of roadkills. These mile sections will be randomly covered (jacketed) for a week, with two sections in operation at one time. This design should help reduce bias due to weather.

### 7.8.4 Springs Development - Cottonwood Gulch

In the Fall of 1981 an existing spring in Cottonwood Gulch was developed. The water from the spring was seeping out in several places making the rate of flow indeterminable. The spring was developed by burying a perforated collection pipe through the seeps. An unperforated pipe was then run on top of the ground approximately 100 yards downstream to a watertrough. The flow was probably between 2 to 3 gallons per minute through the pipe. The spring development will be checked next year to determine its use for livestock and wildlife watering.

### 7.8.5 Future Possible Mitigation Projects

Several mitigation projects have been proposed including: additional bush beating in selected draws, approved burnings, planting seedlings in chained areas, fencing for better cattle distribution, additional stock tanks and water wells, proposed dams for water storage which could create waterfowl wetlands and additional fishery habitat.

## 7.9 Off-Tract Corridors

See Utility Corridors, Section 4.2.5 and Electric Power and Switching Facilities, Section 4.1.5.

## 7.10 Abandonment

The Abandonment Plan is contained in Supplemental Material to Detailed Development Plan Modifications submitted July, 1977. The plan is still valid. It will be updated with detailed specification for OSO approval prior to actual abandonment.

## 7.11 Permit Status

A C.B. permit status report of permits obtained to date is presented on Table 7-3.

TABLE 7-3
C.B. PERMIT STATUS REPORT
CURRRENT PERMITS/NOTICES

| Permit Title | Purpose | Permitting Agency | Permit No. | Date Submitted | Date Approved | Date of Expiration | Remarks |
|---|---|---|---|---|---|---|---|
| Air | | | | | | | |
| 1) PSD | For Ancillary Development | EPA | | 10/17/77 | 12/15/77 | For construction of of facilities beyond ancillary production design. | |
| 2) Fugitive Dust Permit | Surface disturbance | CAQCD | C-11, 454 (FD) | 6/27/77 | 12/28/77 Rev 8/05/80 | Indefinite | |
| 3) Emission Permit | Concrete Batch Plant | CAQCD | C-11, 931-(1-5) | 5/18/78 | 6/23/78 | Indefinite | |
| 4) Open Burning Permit | Dynamite disposal | CAQCD | 860-0B-004 | 3/82 | 3/82 | 4/83 | Permit has been taken out of Gilbert's responsibility and placed in CBSOC name. |
| 5) Emission Permits (7) | Natural gas generators | CAQCD | C-12, 128 (1-7) | 9/11/78 | 12/26/78 | Indefinite | |
| 6) Emission Permits (4) | Natural gas generators | CAQCD | C-12, 255 (1-4) | 12/04/78 | 3/15/79 | Indefinite | |
| 7) APEN | Feeder Breaker | CAQCD | C-13, 244 (FD) | 3/06/81 | 4/20/81 (State) 5/18/81 (EPA) | | |

## C.B. PERMIT STATUS REPORT
## CURRENT PERMITS/NOTICES

| Permit Title | Purpose | Permitting Agency | Permit No. | Date Submitted | Date Approved | Date of Expiration | Remarks |
|---|---|---|---|---|---|---|---|
| Water | | | | | | | |
| 1) NPDES | Water discharge to Piceance Creek | CWQCD | CO-0033961 | 8/19/77<br>Rev<br>6/30/80 | 3/27/79<br><br>12/8/80 | 12/31/82 | The WQCD is in the process of revising the permit criteria including the additional discharge points as requested 6/30/80. |
| 2) SPCC | To comply with the Clean Water Act | CWQCD, OSO, EPA | | 11/79 | Not required | Update required every 3 years | SPCC plan currently being revised. Anticipate update to be complete by Spring 1982. |
| 3) Water Augmentation Plan | Depletion Mitigation | Water Court | W-3492 | 8/31/77 | 5/21/79 | Project Life | |
| 4) Well Permits (34) | Covers permits for 29 wells and 5 shafts filed under Augmentation Plan for any beneficial use. | State Engineer | W-3493 | 8/31/77 | 5/21/79 | | |
| 5) Sewage Plant Site Approval | Sewage plant | CWQCD | Site 2852 | 8/06/80 | 8/28/80 | | |
| 6) Sewage Plant | Sewage disposal | CWQCD | Site 2852 | 9/22/80 | 11/03/80 | Indefinite | 9000 gal/day activated sludge secondary treatment package plant is now operational. |
| 7) Little Gardenhire Dam Permit | Dam construction | Colo.Dept. of Natural Resouces, State Eng. | C-1591 | | 8/27/80 | | |

# C.B. PERMIT STATUS REPORT
## CURRENT PERMITS/NOTICES

| Permit Title | Purpose | Permitting Agency | Permit No. | Date Submitted | Date Approved | Date of Expiration | Remarks |
|---|---|---|---|---|---|---|---|
| Land<br>1) Lease | Tract C-b development | USGS/OSO | C-20341 | | 4/74 | 4/96 | Update required on disturbed acreage in accord with Mined Land Reclamation Plan. Bonding level must be revised accordingly. Annual lease payment made 3/16/82 for 4/1/82-3/31/83. Annual report due to OSO April 30. |
| 2) DDP & MDDP | Lease compliance | USGS/OSO | N/A | 2/77 | 8/77 | | |
| 3) Monument Peak Right-of-Way | Microwave communi-cations | BLM | C-25677 | 7/31/77 | 10/20/77 | Indefinite | |
| 4) Road Right-of-Way | Construct access road | BLM | C-15827 RW | 9/13/77 | 1/24/78 | Indefinite | |
| 5) Notice of Prospecting | Site preparation and shaft sinking activities | CMLRB | | 3/77 | Not required | | |
| 6) ROW/SLUPS | Monitoring wells and access roads | | C-22010<br>22011<br>22804<br>28390 | | | | TUPS & SLUPS Expire: BLM will include all under C-22804 as a 30 year ROW. Action is in progress. |
| 7) Mined Land Reclamation Plan | Surface disturbance reclamation | CMLRB | 77-530 | 11/07/77 | 3/23/78 | | Annual reclamation report and fee submitted 3/22/82. |
| 8) Special Use Permit | Permanent zoning | Rio Blanco | | 10/10/78 | | Indefinite | Follows original DPP. |
| 9) MLRB Plan | Sewer Plant site | MLRB | | | 8/28/80 | Indefinite | Sewer plant and access road. |

# C.B. PERMIT STATUS REPORT
## CURRENT PERMITS/NOTICES

| Permit Title | Purpose | Permitting Agency | Permit No. | Date Submitted | Date Approved | Date of Expiration | Remarks |
|---|---|---|---|---|---|---|---|
| Resource Conservation and | Recovery Act (RCRA) | | | | | | |
| 1) Notice of hazardous waste activity | Generate & ship hazardous waste | EPA | EPA ID# COD 000 716530 | 8/18/80 | | | |
| Others | | | | | | | |
| 1) FCC Licenses (3) | Microwave communi-cations | FCC | (15562-IP-67X) (15563-IP-67X) (15564-IP-67X) | 5/31/77 | 8/02/77 | 8/02/82 | Stations located at Grand Mesa, Monument Peak, and C-b Tract. |
| 2) Notice to FAA of Pro-posed Construction | Structures over 200 ft. | FAA | | 8/18/78 | None Required | | |
| 3) Heliport Location | Heliport construction | DOI/OSO, FAA | | 4/26/80 | 4/26/80 | Indefinite | |
| 4) Radioactive Materials License | Operate neutron moisture probe for soil moisture monitoring spinkler plots. | Colo.Dept. Health | Colo 437-0 | 5/01/80 | 6/31/80 | 6/31/85 | Source to be tested every 6 months. Annual assessment by management. Source tested 3/82. |
| 5) TSCA-Inventory of Chemical Substances | Registration of shale oil | EPA | | 4/26/78 | | | Shale oil (from any and all processes) is on the inventory of existing chemical substances. A premanufacture notice will not be required. |

## 8.0 SOCIOECONOMIC ACTIVITIES

Socioeconomic activities include analysis of the workforce and the associated population buildup, Mitigation Task Force support, workers programs, community donations and public relations. Each is discussed in turn.

### 8.1 Work Force

The work force at the C-b site increased during 1981 from a level of 500 employees in January to an employment peak of 685 in November and a year-end level of 600 employees. Total persons employed directly by Cathedral Bluffs decreased slightly from 120 in January to 110 in December.

The majority of C-b site employees reside in Rifle, but the percentage of total employees residing in Rifle declined during the year. Table 8-1 reflects the residential distribution of C-b employees in January and in October. The decrease in percentage of employees residing in Rifle was offset by an increase in Meeker. The reason for the shift in residential distribution was due primarily to two factors. The Project Manager for Brown and Root chose to live in Meeker, and he encouraged his employees to also live in Meeker. Also, layoffs in the Meeker area provided an available labor force for employment at C-b.

### 8.2 Population Buildup

Population growth in the Rifle area was rapid during 1981, with the principal growth stimuli resulting from increased employment at the Colony and Union Oil Shale Projects. On the other hand, population in Meeker remained basically stable throughout the year.

### 8.3 Transportation

The C-b employee bus system was expanded in 1981 from eight to ten operating buses. An estimated total of $775,000 was expended on lease and operating costs for the bus system. Based on the transportation data, approximately 60% of Tract personnel utilized the buses. Average bus passengers per trip (47-passenger bus capacity) were 24 and 14 for Rifle and Meeker respectively for 1981 compared to 25 and 9 for 1980. Total round trip passengers transported to Rifle and Meeker respectively were 46,373 and 18,540 in 1981 compared with 45,534 and 9,692 in 1980.

C.B. participated during 1981, along with four other oil shale projects, in joint financial sponsorship of the construction of a highway by-pass route in Rifle. C.B. has deposited $71,050 in an escrow account to support the project. It is likely, due to a lower than expected construction bid, that a portion of the committed funds will not be necessary and will be returned to the C.B. project.

### 8.4 Housing

C.B. continued to lease 111 apartment units in Rifle and Meeker and operate the 103 unit King's Crown mobile home park in Rifle for employee housing. See Figure 8-1. The total net cost of operating employee housing was

TABLE 8-1

Residential Distribution of C.B. Employees (Percent)

| | January 1981 | October 1981 |
|---|---|---|
| Rifle | 62 | 52 |
| Meeker | 12 | 26 |
| Silt | 6 | 6 |
| Grand Junction Area | 6 | 5 |
| Glenwood Springs | 2 | 2 |
| New Castle | 3 | 2 |
| Parachute | 2 | 2 |
| Rangely | 0 | 0 |
| Other Western Slope | 1 | 1 |
| Piceance Creek | 1 | 0 |
| Other Colorado | 1 | 0 |
| Outside Colorado | 1 | 0 |
| Unknown | 3 | 1 |
| TOTAL | 100 | 100 |

Figure 8-1. King's Crown mobile home park - Rifle (looking northwest). (August 1981)

$232,266. Drainage improvements and construction of a recreation vehicle storage area were completed at King's Crown.

Preliminary site planning was done for the Condon Parcel, a 113 acre parcel of land in Rifle owned by the C.B. project. The land is proposed to be developed into approximately 550 total housing units, arranged in a mix between apartments, townhouses and mobile homes.

## 8.5 Mitigation Task Force Support

At the end of March, services of the consultants (Pace Quality Development Associates, Inc.) who had been performing task force support for C.B. were terminated. An in-house Community Relations Manager was hired in May and was stationed in Rifle. Part of his responsibility is to provide ongoing technical support to the impact mitigation task forces in Rio Blanco and Garfield Counties.

Linked to Rio Blanco County's inducement resolution to issue pollution control bond financing for C.B., an agreement as executed between C.B. and the County calling for the development of a socioeconomic impact mitigation program. This program is being developed jointly by representatives of C.B. and Rio Blanco County.

## 8.6 Worker Programs and Monitoring

The C.B. socioeconomic monitoring reports were produced on a quarterly basis by the Public Affairs Department. Preparation of these reports was shifted from a consultant to an in-house function in April. The compilation of community economic and demographic data has been discontinued in the monitoring reports. The survey format used in the employee monitoring program has been revised at the request of local government officials.

## 8.7 Community Donations

Table 8-2 lists the budgeted contributions made by C.B. to various community projects in 1981. In addition to these budgeted contributions, C.B. agreed to contribute up to $71,050 to the highway by-pass construction in Rifle, and contributed $75,000 to Rio Blanco County to cover costs for the preparation of a socioeconomic impact mitigation agreement.

## 8.8 Public Relations

### 8.8.1 C-b Tract Tours

During 1981 Public Relations conducted 218 tours at the Tract. Of these 41% were industry related, 30% governmental, 27% educational and 2% media related. There were a total of 1,852 visitors involved with these tours. This represents a 77% increase in the number of tours compared to 1980.

TABLE 8-2a

Cathedral Bluffs - Contribution Status Schedule as of December 31, 1981

| | Actual @ 12/31/81 |
|---|---|
| W. Garfield Recreation District | $ 2,500.00 |
| Flight for Life | 6,000.00 |
| City of Meeker | 4,575,00 |
| City of Rifle | 4,100.00 |
| Meeker Hospital | 2,500.00 |
| Rifle Hospital | 2,500.00 |
| Garfield Youth | 2,500.00 |
| Community Services - Meeker | 700.00 |
| Community Services - Rifle | 1,500.00 |
| Rifle 4-H | 340.70 |
| Mt. States Legal Foundation | 500.00 |
| Meeker Plant Materials Center | 5,000.00 |
| "Up With People" | 16,625.00 |
| Misc.* | 2,850.00 |
| Shriners | 105.00 |
| TOTAL | $52,295.70 |

*See Table 8-2b

TABLE 8-2b

Miscellaneous Contribution Listing

| Cathedral Bluffs | Actual @ 12/31/81 |
|---|---|
| Rock School Student Body | $ 400.00 |
| Career Outreach Program | 250,00 |
| Centennial Colorado Conference | 112.50 |
| Community Office/Minority Aid | 112.50 |
| Burning Mountain Festival Committee | 75.00 |
| Western Slope Training Academy | 1,000.00 |
| Drapes at Meeker Hospital | 150.00 |
| Meeker Football Mothers | 100.00 |
| Community Concert Association-Meeker | 100.00 |
| ESMA Lewis Elementary | 50.00 |
| Meeker Fire Department | 400.00 |
| Center on Deafness | 100.00 |
| TOTAL | $2,850.00 |

### 8.8.2 Lectures, Presentations, Expositions

A total of 168 lectures and/or presentations were made off-Tract by various members of the Public Relations staff in 1981. In addition, there were five expositions at which models of the Tract were displayed.

### 8.8.3 Photography

A total of 135 photographic work requests were completed and the chronological historical file of 35 mm color slides was updated monthly to record progress. Several film crews, including all three national networks and Armand Hammer Productions, were given assistance while filming on-Tract.

### 8.8.4 Other Activities

Public Relations arranged and coordinated two evening performances and four days of activities for the 100 member cast of "Up With People", a musical group who performed in Rifle and Grand Junction sponsored by the C.B. project. All radio, television and newspaper promotional ads were prepared by Public Relations.

Work began in 1981 for the 1982 World's Fair participation and exhibit by the C.B. project in Knoxville, Tennessee.

An employee summer picnic was held at Powderhorn in July. Two photos taken at this event are shown on Figures 8-2 and 8-3.

Figure 8-2. Pie eating contest at the employee's summer picnic at Powderhorn. (July 1981)

Figure 8-3. Little people in the sack race - employee's summer picnic at Powderhorn. (July 1981)

# 9.0 ENVIRONMENTAL MONITORING

## 9.1 Scope

The Environmental Baseline Period for Oil Shale Tract C-b covered the period from November 1, 1974, to October 31, 1976. Results have been reported in nine Quarterly Data Reports, eight Quarterly Summary Reports, C-b Annual Summary and Trends Report (1976), and a 5-volume Environmental Baseline Program Final Report (1977), all submitted to the Oil Shale Supervisor.

From November 1, 1976 through August 31, 1977, the C-b Tract was under a period of suspension of the Federal Oil Shale Lease. The monitoring conducted during this period was executed under a program known as the Interim Monitoring Phase. Environmental data for this time period were submitted to the Oil Shale Office (OSO) on October 14, 1977 (Interim Monitoring Report #1). The Interim Monitoring Period was later extended by the OSO to cover the period from September 1, 1977 through March 31, 1978. Data for this time period were submitted to the OSO on May 15, 1978 (Interim Monitoring Report #2). The Development Monitoring Program was initiated in April 1978. The Development Monitoring Program for Oil Shale Tract C-b was submitted to the OSO in a document dated February 23, 1979 and approved by the OSO on April 13, 1979 subject to thirteen Conditions of Approval contained in the approval letter. Semi-annual environmental data reports are submitted every January 15 and July 15.

The Interim Monitoring and Development Monitoring Programs have been reduced and changed from the Environmental Baseline Monitoring Program in many areas. Therefore, emphasis is now placed on key indicators of environmental quality and/or change. The 1981 C.B. Annual Report, Volume 2 provides detailed data analysis.

## 9.2 Purpose

The purpose of Volume 2 of this report is to fulfill the requirement of the lease to provide the Oil Shale Supervisor's Office with an annual report of environmental analyses. The Development Monitoring Plan states the following objectives with respect to environmental monitoring:

> The purposes or objectives of environmental monitoring as defined in Section 1 (C) of the Stipulations are to provide: (1) a record of changes from conditions existing prior to development operations, as established by the collection of baseline data, (2) a continuing check on compliance with the provisions of the Lease and Stipulations, and all applicable Federal, State and local environmental protection and pollution control requirements, (3) timely notice of detrimental effects and conditions requiring correction, and (4) factual basis for revision or amendment of the Stipulations.

The approach taken in the Development Monitoring Program utilizes the simple, multicomponent, conceptual model shown on Figure 9-1. The "outputs" or actions constitute the Development Monitoring Plan and its implementation (findings) as a result of monitoring (Box 4). "Inputs" consist of the environmental data base, the Lease Environmental Stipulations, the details of Tract operation, and applicable local, state, and federal regulations (Box 1). The mid-component or "decision matrix" (Box 2) consists of the three major criteria

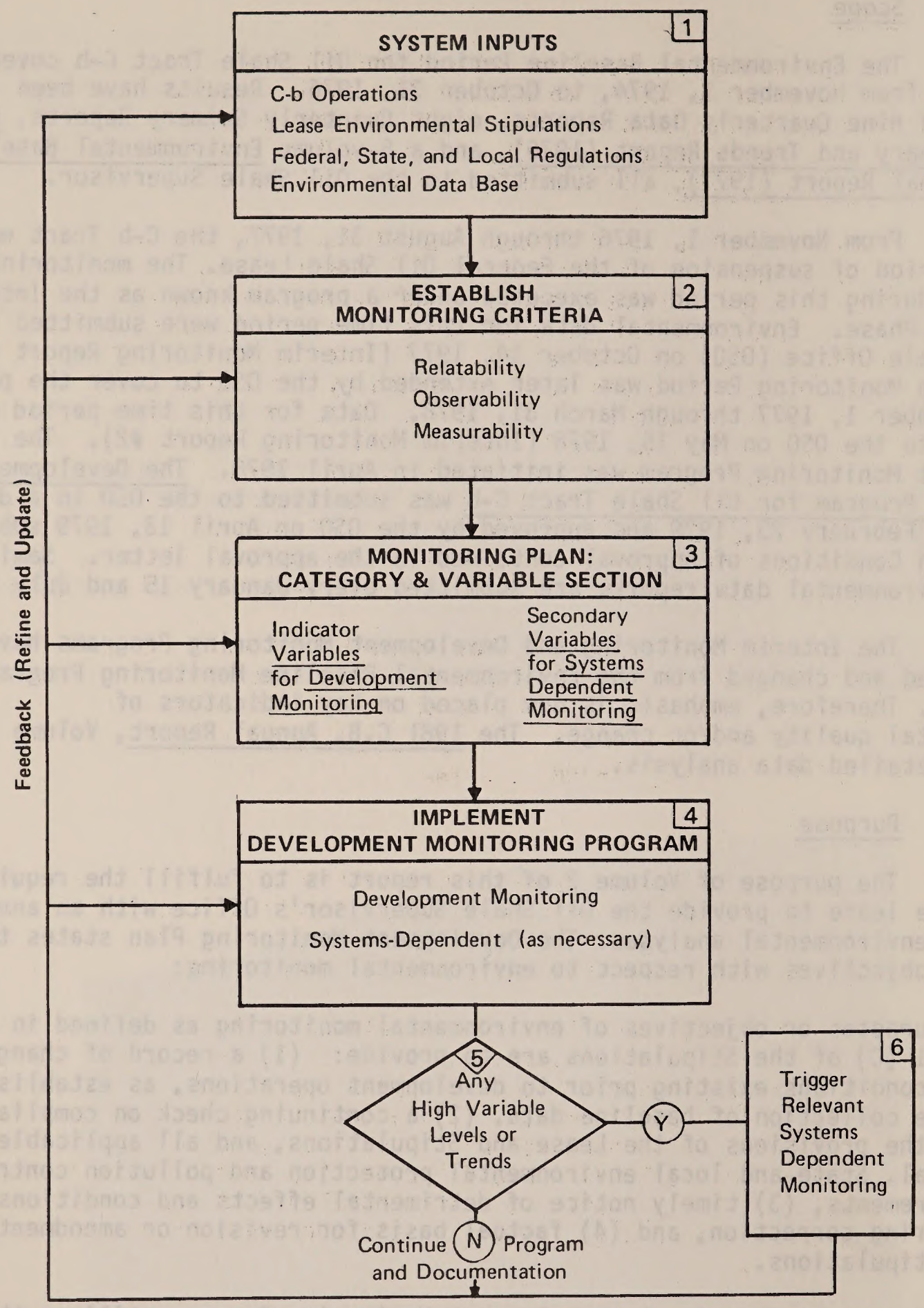



Figure 9-1
Conceptual Approach to Development Monitoring

to which candidate variables for monitoring are subjected (relatability, observability, and measurability). The selected variables in the Program which are "screened" by these criteria become known as indicator variables. A significant feature of this conceptual model is its feedback capability. That is, variable levels are assessed against "expected" levels (Box 5). In the event that high levels are obtained, a "systems dependent" mode of either more intensive monitoring, use of additional stations, or added variables (or all three) is triggered in Box 6. Feedback from the program results to date to obtain improved inputs ensures continual review and refinement of the monitoring programs as additional information is collected and analyzed. This is a provision not only for the evolution of the monitoring program in terms of methods used in collecting and analyzing data and for refining sampling frequencies and locations, but also a provision for factoring in the phases of development and their subsequent effects on the system.

Volume 2 documents the analyses and conclusions relative to assessment of potential environmental impacts and trends that may be indicated by the collected data. Since development activities were not started until 1978, much of the data and analyses may be considered as a continuation of environmental baseline and background definition.

## 9.3 Summary of Environmental Monitoring

Environmental monitoring and analyses are continuing on Tract C-b. Development activities commenced within the past four years have resulted in increased activity on the Tract in the form of off-road vehicular use, facility construction, shaft sinking and outfitting associated headframes, and traffic into and out of the area. All activity has been conducted within strict adherence to environmental, permit, and lease regulations. Environmental impacts, where they exist, have been confined to the immediate Tract and within limits defined in the Detailed Development Plan.

### 9.3.1 Indicator Variables

The Development Monitoring Program has been brought into sharper focus with the identification of Class 1 indicator variables. These are key environmental variables collected at representative stations in at least monthly sampling frequency. Time series plots, generated by the computer from the data base and all to a common time scale, are updated in the semi-annual data reports to provide visual analyses of trends and interrelationships. As a statistical screening process, linear short- and long-term trends have been examined at a five percent level of significance for air and water and to 20 percent for biology; results are discussed in the respective chapters.

### 9.3.2 Tract Imagery

A photographic record of Tract changes has been continued through 1981 as in previous years. A 360° horizontal pan is photographed in color on a yearly basis at 35 photo points. Color infrared panoramic photographs of the vegetation around springs and seeps were obtained three times during the growing season.

Landsat digital imagery was used as in previous years to monitor vegetative condition in the Tract vicinity. Extensive cloud cover throughout every Landsat pass during the peak growing season precluded new data in 1981; that is, in each of the five overflights (every 18 days) from June thru August cloud cover existed.

### 9.3.3 Hydrology

A development monitoring program has been implemented to provide water quantity and quality data for the purpose of impact evaluation. Streams, springs, seeps, alluvial and bedrock aquifers, shafts and impoundments are presently monitored. The monitoring station locations are shown in Figures 9-2, 9-3, 9-4, and 9-5.

Baseline studies indicated the mean flow for the reach of Piceance Creek adjacent to the Tract to be approximately 13 cfs. Records since then indicate no significant change in mean annual flows; that for 1981 was 7 cfs (Station WU07). One-day minimum flows there have been as low as 1 cfs. Maximum of the mean daily flows upstream and downstream of the Tract for water year 1981 were:

| | Upstream (Station WU07) | Downstream (Station WU61) |
|---|---|---|
| Previous Maximum of the Mean Daily Flow (cfs) | 157 (May, 1979) | 149 (May, 1979) |
| 1981 Maximum of the Mean Daily Flow (cfs) | 19 (Nov. 1980) | 34 (Nov. 1980) |

Maximum of the mean daily flows has exhibited substantial variability over the years; for example at Station WU61:

| | |
|---|---|
| 1978 (June) | 60 cfs |
| 1979 (May) | 149 cfs |
| 1980 (May) | 121 cfs |

and the above value of 34 which occurred in water year 1981 (in November, 1980). In 1981 maximum flows were low because both snowpack, the rate of snowmelt, and hence, runoff were low in the Piceance Basin.

The flow of groundwaters are governed by the stratigraphy of the Tract (Figure 9-6). The arrangement of aquifers and aquicludes (or aquitards) employ the terms Upc1, Upc2, Lpc3 and Lpc4, representing in descending order four aquifer identifications in the Upper Parachute Creek and Lower Parachute Creek Formations. This conceptual model was derived in 1978 from the two exploratory core holes that preceded the sinking of the V/E Shaft and the Service and Production Shafts and reinforced by shaft-sinking results. Water producing and non-water producing zones were identified by pump-spinner tests run in the core holes. From the pump-spinner tests, the Four Senators zone was considered an aquiclude or aquitard between Upc1 and Upc2. The Mahogany Zone which has for many years been considered an aquiclude or an aquitard, showed water production in its lower part during the pump-spinner tests. Therefore, only the upper 25 feet of the Mahogany Zone was considered in this model as a barrier between Upc2 and Lpc3. The lowest of the four aquifer units, Lpc4, includes most of the R-5 and L-4 zones (U. S. Geological Survey System). No boundary was designated to separate the Uinta from Upc1.

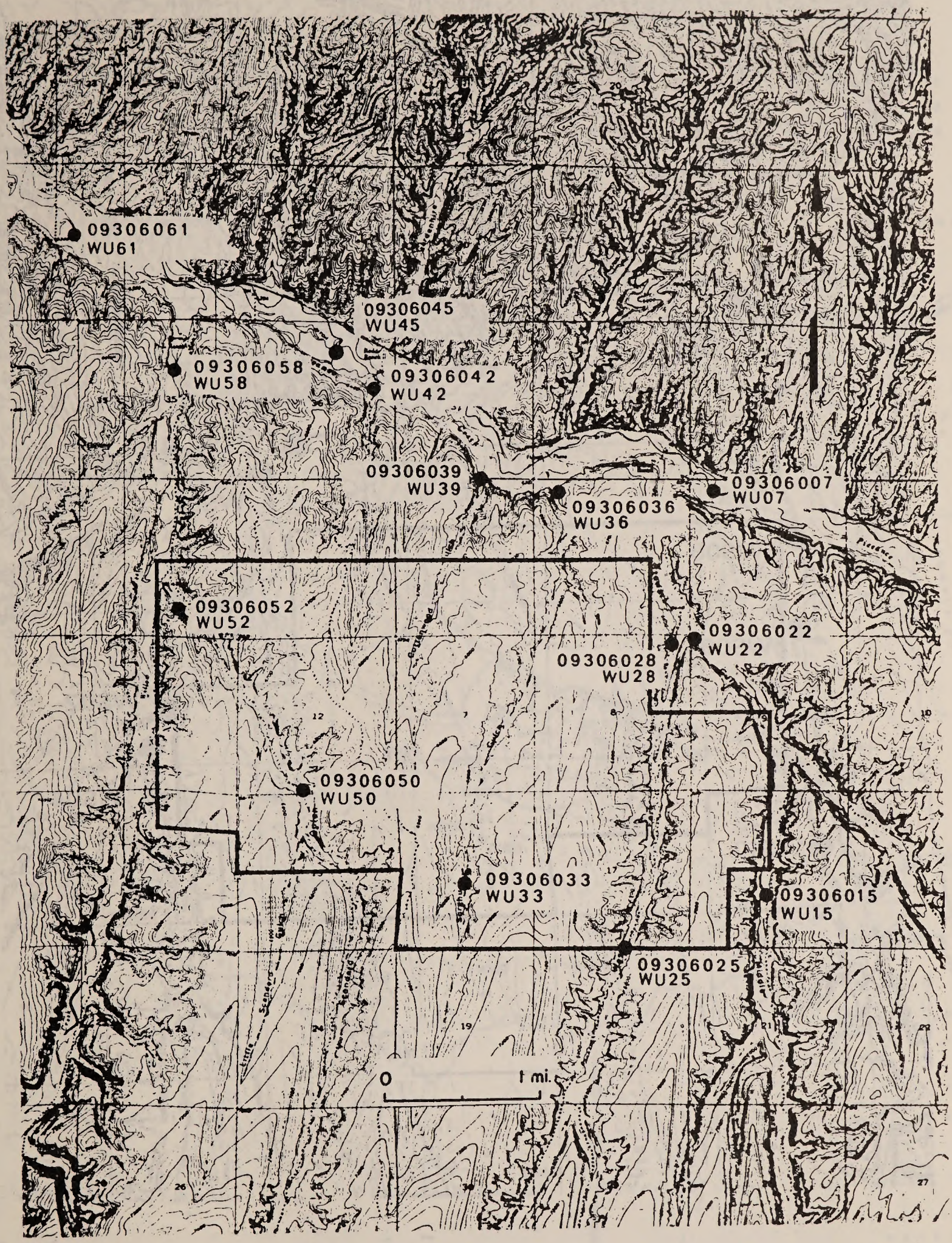



Figure 9-2
U.S.G.S Stream Gauging Station Monitoring Network

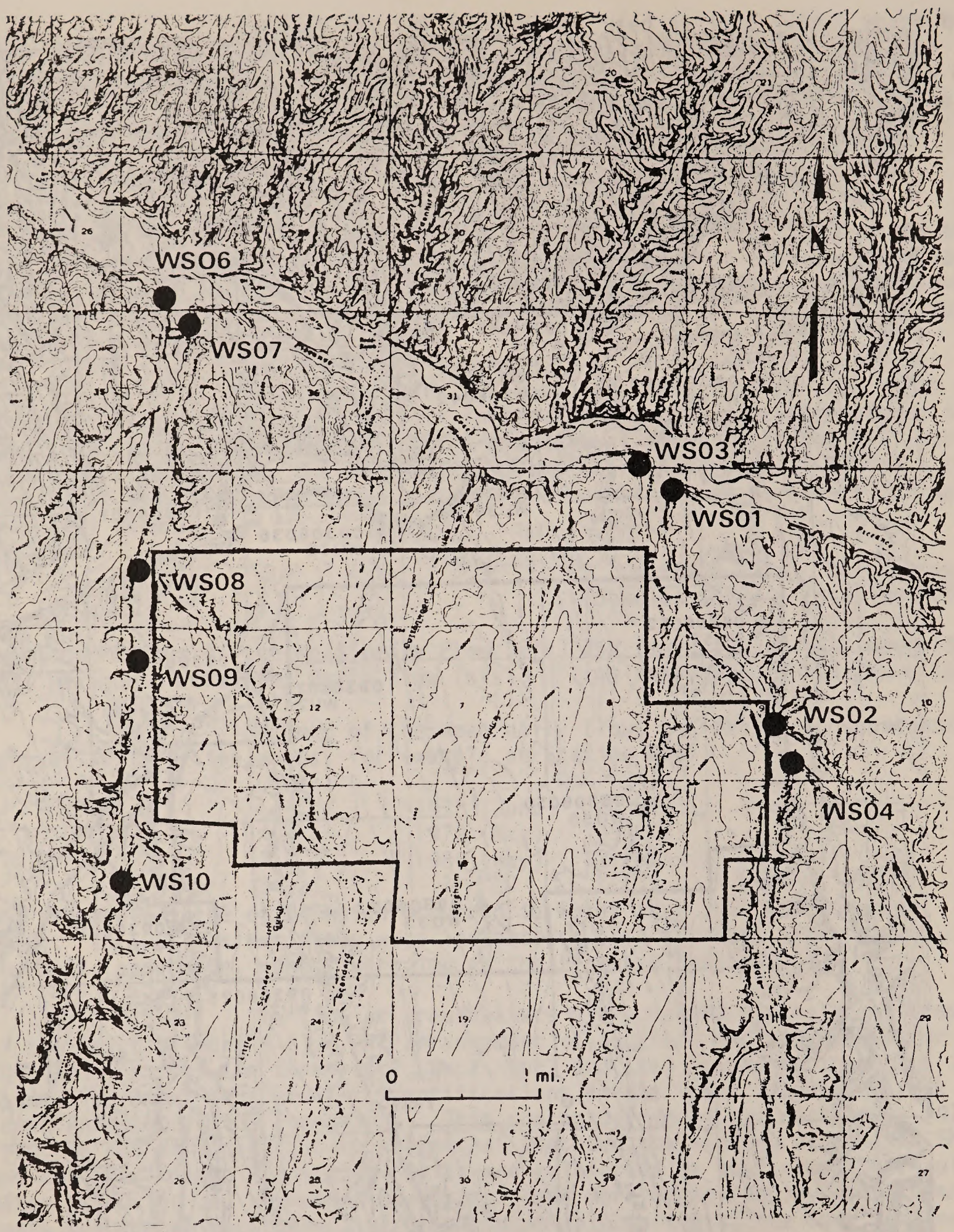



Figure 9-3a
Springs and Seeps Monitoring Network
Near Track

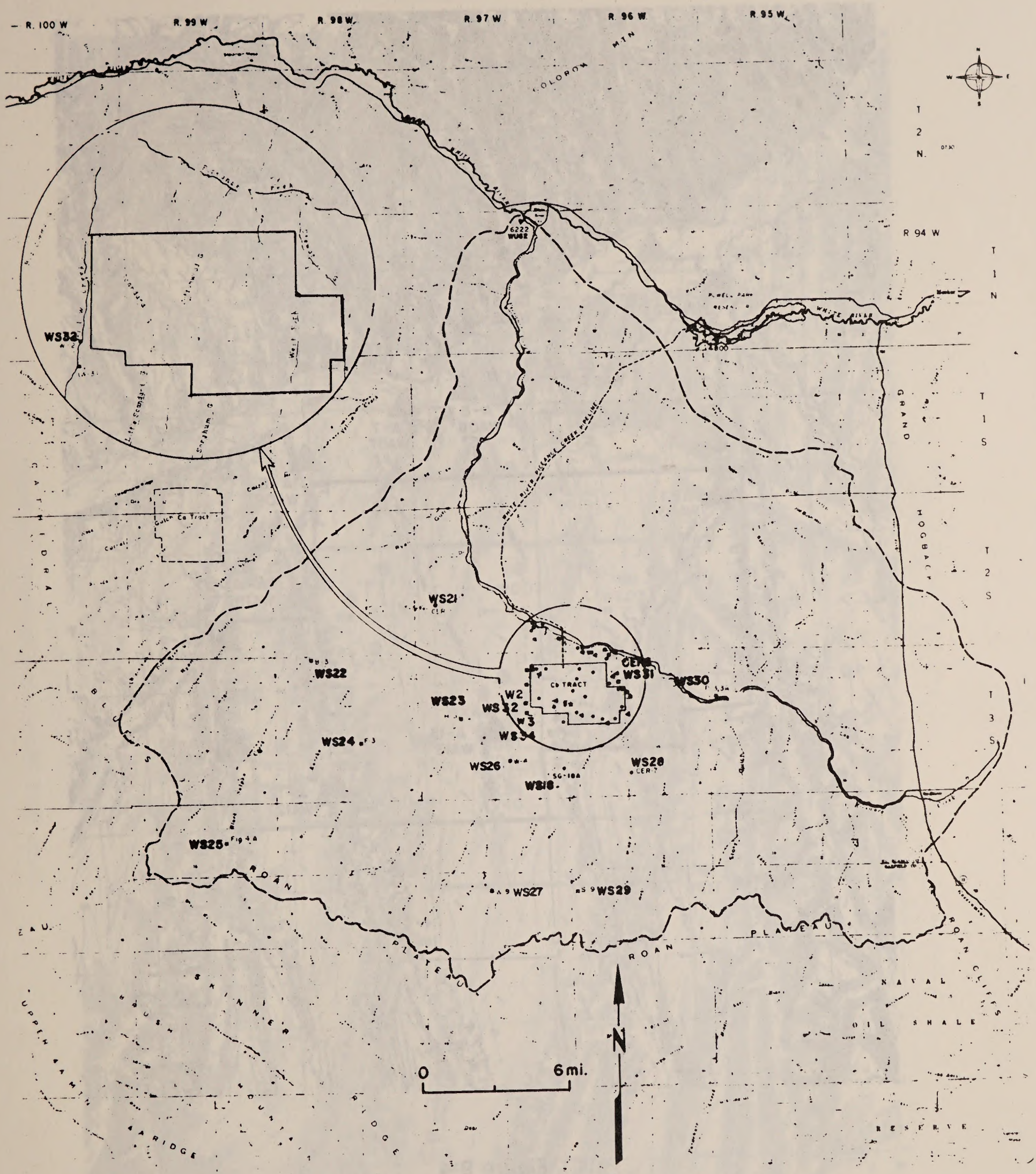



Figure 9-3b
Springs and Seeps Monitoring Network
Off-Tract

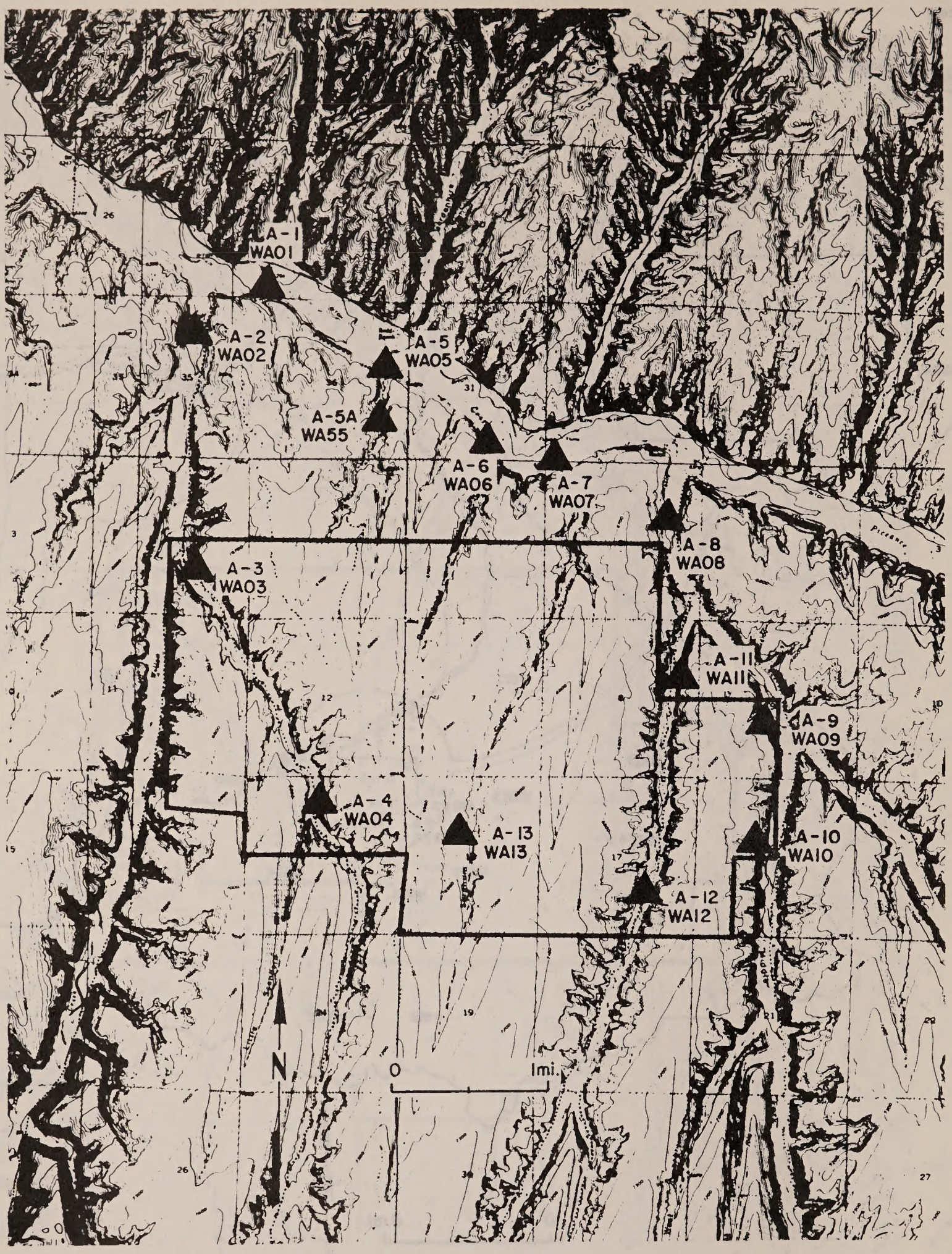



Figure 9-4
Alluvial Aquifer Monitoring Network

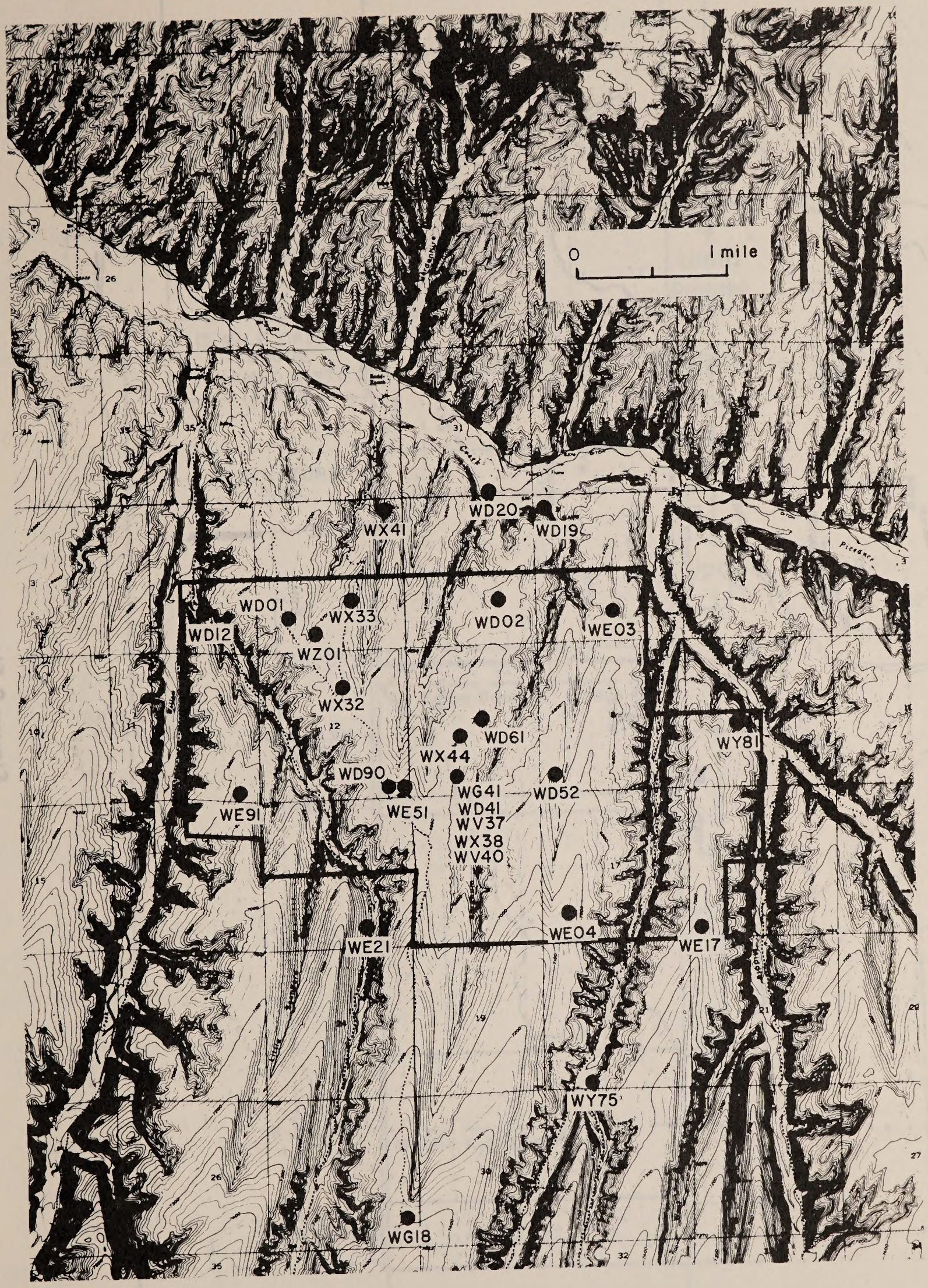



**Figure 9-5a**

DEEP WELL MONITORING NETWORK NEAR C-b TRACT

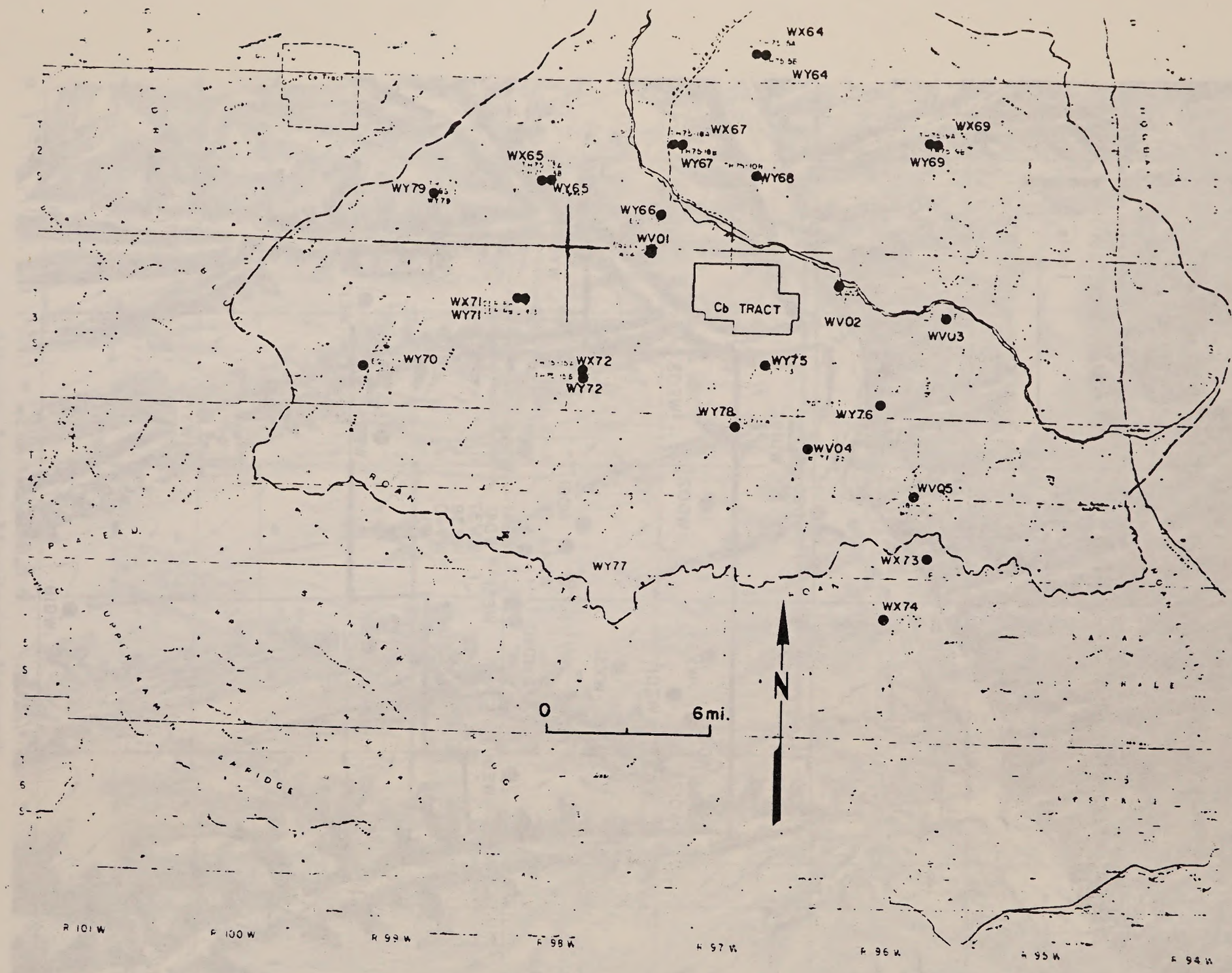



**Figure 9-5b**
**Deep Well Monitoring Network Off-Tract**

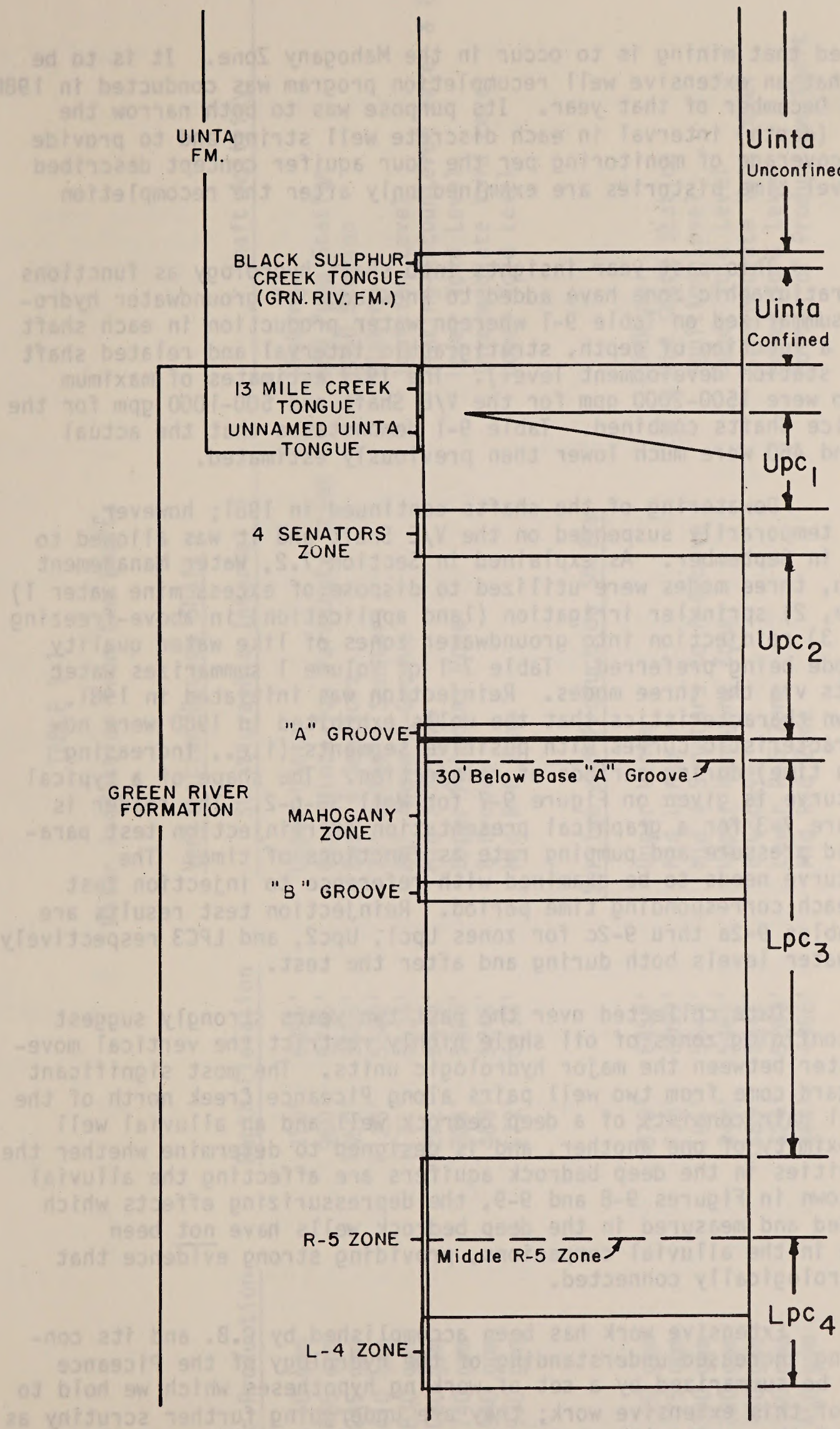



**Figure 9-6**
**Generalized Stratigraphy C-b Tract**

It is to be noted that mining is to occur in the Mahogany Zone. It is to be further noted that an extensive well recompletion program was conducted in 1980 and finished in December of that year. Its purpose was to both narrow the monitoring well (depth) interval in each discrete well string and to provide better overall coverage of monitoring per the four aquifer concept described above. Well level time histories are examined only after the recompletion date.

This past year insights into shaft hydrology as functions of depth and stratigraphic zone have added to knowledge of groundwater hydrology. This is summarized on Table 9-1 whereon water production in each shaft is presented as a function of depth, stratigraphic interval and related shaft activity (i.e., station development level). The 1977 estimates of maximum water production were 1500-2000 gpm for the V/E Shaft and 500-1000 gpm for the Production/Service Shafts combined. Table 9-1 demonstates that the actual peaks of 1060 and 460 were much lower then previously estimated.

Dewatering of the shafts continued in 1981; however, operations were temporarily suspended on the V/E Shaft and it was allowed to flood beginning in September. As explained in Section 7.2, Water Management and Augmentation, three modes were utilized to dispose of excess mine water 1) direct discharge, 2) sprinkler irrigation (land application) in above-freezing periods, and/or 3) reinjection into groundwater zones of like water quality with the last mode being preferred. Table 7-1 of Volume 1 summarizes water treatment amounts via the three modes. Reinjection was initiated in 1981. Thus the drawdown characteristics that the wells exhibited in 1980 were now replaced by characteristic curves with positive segments (i.e., increasing water level with time) during periods of reinjection. The shape of a typical characteristic curve is given on Figure 9-7 for Well SG-6-2. The reader is referred to Figure 7-3 for a graphical presentation of reinjection test parameters: well-head pressure and pumping rate as functions of time. The characteristic curve needs to be examined with reference to injection test parameters for each corresponding time period. Reinjection test results are summarized on Tables 9-2a thru 9-2c for zones Upc1, Upc2, and LPC3 respectively for changes in water levels both during and after the test.

Data collected over the past two years strongly suggest that the tight confining zones of oil shale highly restrict the vertical movement of groundwater between the major hydrologic units. The most significant data in this regard come from two well pairs along Piceance Creek north of the Tract. Each well pair consists of a deep bedrock well and an alluvial well within close proximity of one another, and is designed to determine whether the dewatering activities in the deep bedrock aquifers are affecting the alluvial aquifers. As shown in Figures 9-8 and 9-9, the depressurizing effects which have been detected and measured in the deep bedrock wells have <u>not</u> been observed to date in the alluvial companions, providing strong evidence that they are not hydrologically connected.

Extensive work has been accomplished by C.B. and its consultants regarding increased understanding of the hydrology of the Piceance Basin. This may be summarized by a set of working hypotheses which we hold to be true in view of this extensive work; they are undergoing further scrutiny as further results of the monitoring program become available. These are: 1) lateral or infraformational migration of groundwater may be extremely slow; 2)

TABLE 9-1

Water Production from the Shafts

| Water Production | Depth-Elevation | | Stratigraphic Interval | Shaft Activity |
|---|---|---|---|---|
| **Ventilation/Escape Shaft** | | | | |
| 10 gpm | 310' | 6395' | Upper Uinta | Sinking |
| 165 gpm | 960' | 5745' | Base Uinta-Top Parachute Creek | 960 Pump Station |
| 245 gpm | 1050' | 5655' | Base 4 Senators | 1050 Station |
| 410 gpm | 1123' | 5582' | 75' Below 4 Senators | Sinking |
| 830 gpm | 1171' | 5534' | 80' Above A-Groove | Ignition Level |
| 1060 gpm | 1262' | 5443' | Mid A-Groove | Sinking-Encountered Water & Gas |
| 740 gpm | 1308' | 5396' | Upper Mahogany Zone | Upper Void Level |
| 940 gpm | 1460' | 5245' | B-Groove | Intermediate Void Level |
| 930 gpm | 1573' | 5133' | Mid R-6 Zone | Lower Void Level |
| **Service and Production Shafts** | | | | |
| 20 gpm | 370' | 6459' | Upper Uinta | Sinking |
| 75 gpm | 730' | 6099' | Mid Uinta | Mid Shaft Station |
| 300 gpm | 1185' | 5644' | Mid 4 Senators to A-Groove | Ignition Level |
| 390 gpm | 1348' | 5481' | Upper Mahogany Zone | Upper Void Level |
| 460 gpm | 1489' | 5341' | B-Groove | Intermediate Void Level |
| 460 gpm | 1624' | 5203' | Lower R-6 Zone | Lower Void Level |
| 450 gpm | 1864' | 4966' | Mid R-6 Zone | Bottom of Production Shaft |

TABLE 9-2

Changes in Well Levels During and After Reinjection
a) UPC1

| Well No. | Type of Curve | Change During Reinjection (ft) 3/3-6/30/81 | Change After Reinjection (ft) 6/30/81-9/81 |
|---|---|---|---|
| AT1-A-1 (UPC1-UPC2) | Characteristic Curve | 79 | -45 |
| AT1-D-3 | Characteristic Curve | 36 | -17 |
| C-b 2 | No Trend | 0 | 2 |
| SG1-2 | Subdued Characteristic Curve | 2 | -01 |
| SG1A-2 | Subdued Characteristic Curve | 2 | 0 |
| SG10 | Characteristic Curve | 30 | 15 |
| SG10A-A | Characteristic Curve | 32 | -- |
| SG11-3 | Subdued Characteristic Curve | 9 | -- |
| SG17-3 | No Trend | 0 | -04 |
| SG17-4 | Irregularly Downward | -06 | 2 |
| SG17-A | No Trend | 0 | 1 |
| SG18A-3 | No Trend | 0 | -13 |
| SG19 | Subdued Characteristic | 4 | -- |
| SG20-3 | Subdued Characteristic | 3 | 8 |
| SG21-4 | Subdued Characteristic | 3 | -04 |
| SG6-3 | Subdued Characteristic Curve (communications with 6-1) | 7 | 2 |
| SG9-3 | Subdued Characteristic Curve | 5 | -01 |
| SG9-4 | Slight Upward Trend | 1 | -02 |
| 14X7-1 | Characteristic | 66 | -39 |
| 14X7-2 | Subdued Characteristic | 8 | -25 |
| 32X12 (Upper Aquifer) | | 1 | -05 |
| 71-1 | Subdued Characteristic Curve | 10 | -- |
| 41X13 | Generally Smoothly Upward | 37 | 12 |

b) UPC2

| Well No. | Type of Curve | Change During Reinjection (ft) 3/3-6/30/81 | Change After Reinjection (ft) 6/30/81-9/81 |
|---|---|---|---|
| AT-1A | Characteristic Curve | 81 | -110 |
| ATIC-3 | Characteristic Curve | 79 | -46 |
| AT10-2 | Characteristic Curve | 45 | -45 |
| C-b 1 | Irregular | -05 | -- |
| C-b 3 | Generally Smoothly Downward | -03 | 2 |
| C-b 4 | Generally Smoothly Upward | 4 | 1 |
| SG1A-1 | Generally Smoothly Upward | 1 | -03 |
| SG10A-2 | Characteristic Curve | 110 | -359 |
| SG11-2 | Characteristic Curve | 63 | -07 |
| SG17-2 | Smoothly Upward (Communicates with 17-1) | 11 | -- |
| SG18A-2 | No Trend (Communicates with 18-3) | -01 | -13 |
| SG20-2 | Irregularly Downward | -54 | -72 |
| SG21-3 | Subdued Characteristic Curve (Communicates with 21-2, 4) | 3 | -40 |
| SG6-1 | Subdued Characteristic Curve (Communicates with 6-3) | 7 | 2 |
| SG9-2 | Subdued Characteristic Curve | 23 | -11 |

c) LPC3

| Well No. | Type of Curve | Change During Reinjection (ft) 3/3-6/30/81 | Change After Reinjection (ft) 6/30/81-9/81 |
|---|---|---|---|
| AT-1 | Characteristic Curve | 121 | -10 |
| AT1C-1 | Characteristic Curve | 124 | -116 |
| AT1C-2 | Characteristic Curve | 132 | -129 |
| SG1-1 | Generally Downward | -23 | -08 |
| SG10A-1 | Characteristic Curve | 167 | -195 |
| SG11-1 | Generally Downward | -11 | 62 |
| SG17-1 | Smoothly Upward (Communicates with 17-2) | 11 | -- |
| SG18A-1 | No Trend | 0 | 39 |
| SG21-2 | Subdued Characteristic Curve (Communicates with 21-3, 4) | 3 | -41 |
| SG6-2 | Characteristic Curve | 113 | -98 |
| SG9-1 | Smoothly Downward | -08 | -14 |

FIGURE 9-7

# CB RE-INJECT DATA

SG-6-2

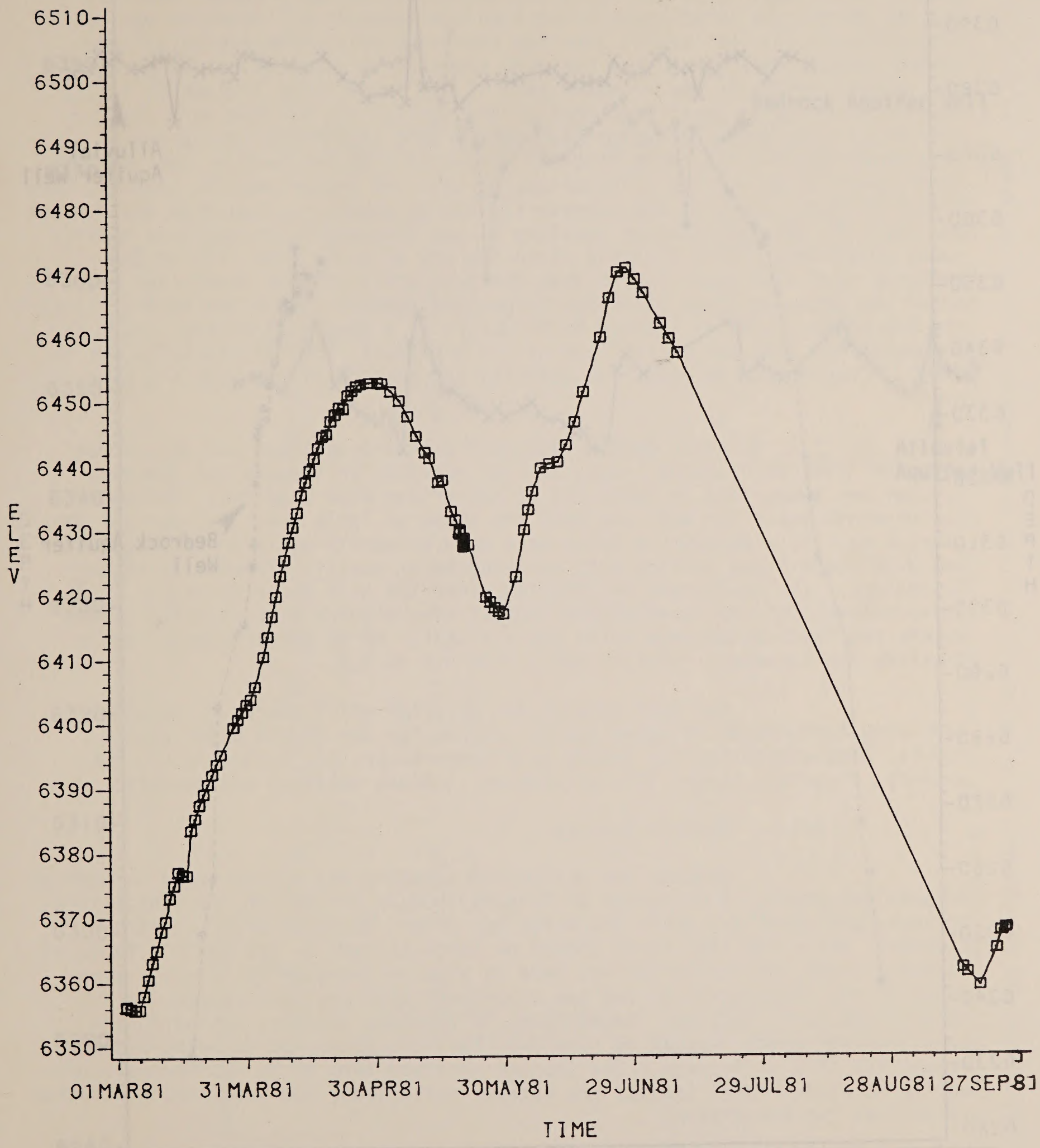
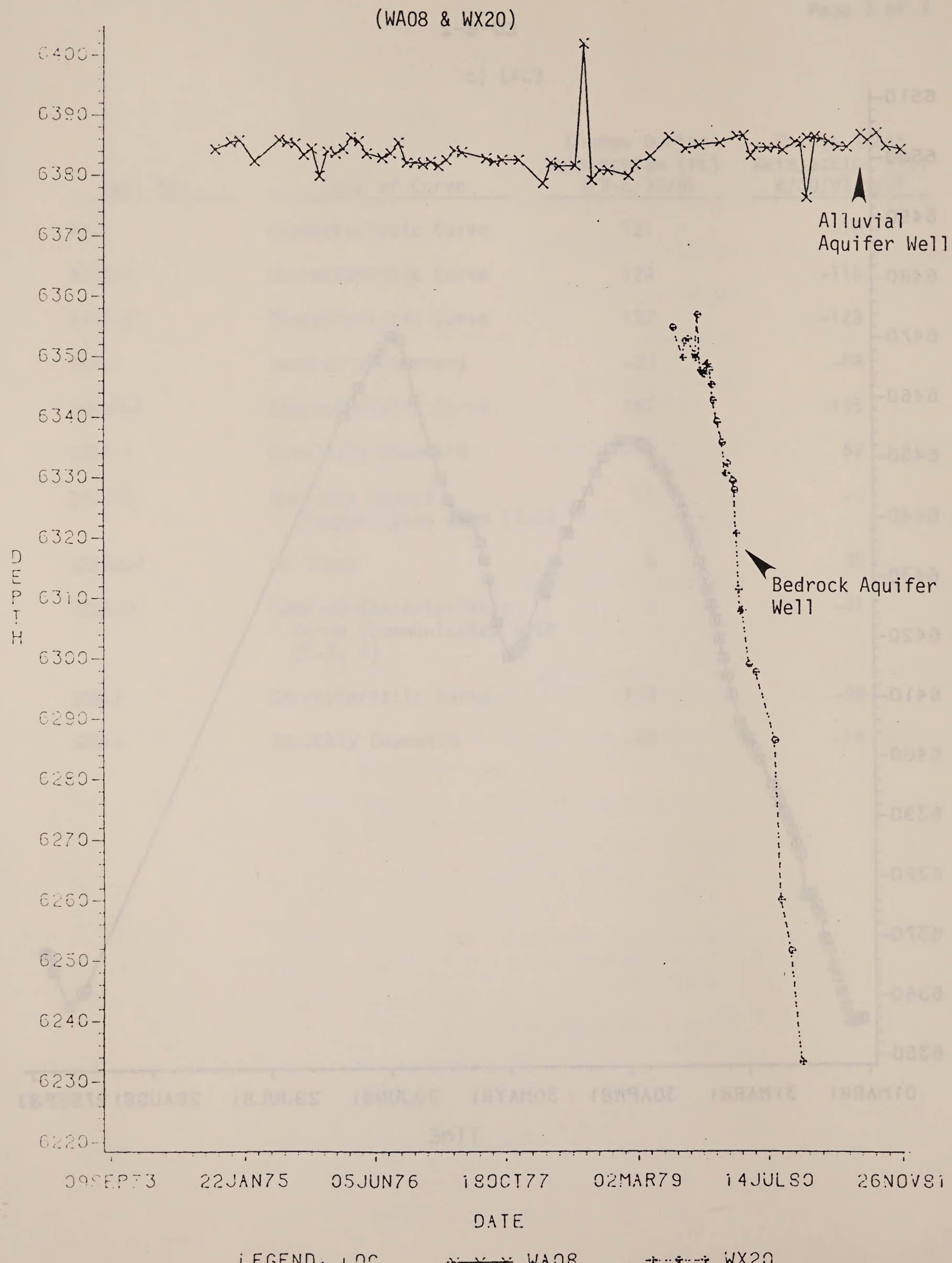
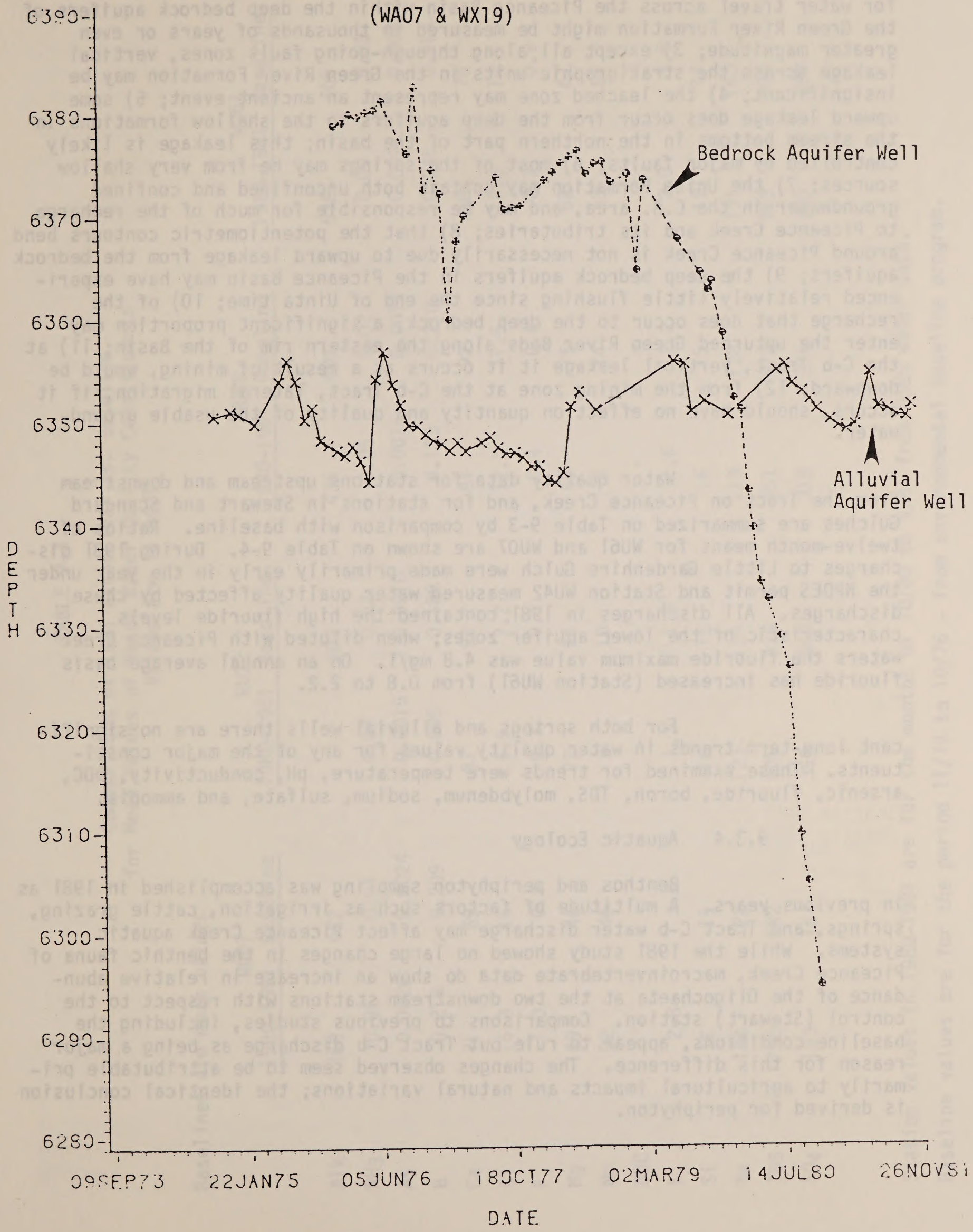


**Figure 9-8**
**Comparison of Water Levels in Cb Well Pairs during Shaft Development**



## Figure 9-9
## Comparison of Water Levels in Cb Well Pairs during Shaft Development



give the range of Darcy velocity values (that exist at C.B.), the maximum time for water travel across the Piceance Basin within the deep bedrock aquifers of the Green River Formation might be measured in thousands of years or even greater magnitude; 3) except all along through-going fault zones, vertical leakage across the stratigraphic units in the Green River Formation may be insignificant; 4) the leached zone may represent an ancient event; 5) some upward leakage does occur from the deep aquifers to the shallow formations in the stream bottoms in the northern part of the basin; this leakage is likely controlled by major faults; 6) most of the springs may be from very shallow sources; 7) the Unita Formation may contain both unconfined and confined groundwater in the C.B. area, and may be responsible for much of the recharge to Piceance Creek and its tributaries; 8) that the potentiometric contours bend around Piceance Creek is not necessarily due to upward leakage from the bedrock aquifers; 9) the deep bedrock aquifers in the Piceance Basin may have experienced relatively little flushing since the end of Uinta time; 10) of the recharge that does occur to the deep bedrock, a significant proportion may enter the upturned Green River Beds along the eastern rim of the Basin; 11) at the C-b Tract, vertical leakage it it occurs as a result of mining, would be downward; 12) from the mining zone at the C-b Tract, lateral migration, if it occurs, should have no effect on quantity and quality of the usable groundwater.

Water quality data for stations upstream and downstream from the Tract on Piceance Creek, and for stations in Stewart and Scandard Gulches are summarized on Table 9-3 by comparison with baseline. Ratios of twelve-month means for WU61 and WU07 are shown on Table 9-4. During 1981 discharges to Little Gardenhire Gulch were made primarily early in the year under the NPDES permit and Station WU42 measured water quality affected by these discharges. All discharges in 1981 contained the high fluoride levels characteristic of the lower aquifer zones; when diluted with Piceance Creek waters the fluoride maximum value was 4.8 mg/l. On an annual average basis fluoride has increased (Station WU61) from 0.8 to 2.2.

For both springs and alluvial wells there are no significant long-term trends in water quality values for any of the major constituents. Those examined for trends were temperature, pH, conductivity, DOC, arsenic, fluoride, boron, TDS, molybdenum, sodium, sulfate, and ammonia.

### 9.3.4 Aquatic Ecology

Benthos and periphyton sampling was accomplished in 1981 as in previous years. A multitude of factors such as irrigation, cattle grazing, springs, and Tract C-b water discharge may affect Piceance Creek aquatic systems. While the 1981 study showed no large changes in the benthic fauna of Piceance Creek, macroinvertebrate data do show an increase in relative abundance of the Oligochaeta at the two downstream stations with respect to the control (Stewart) station. Comparisons to previous studies, including the baseline conditions, appear to rule out Tract C-b discharge as being a major reason for this difference. The changes observed seem to be attributable primarily to agricultural impacts and natural variations; the identical conclusion is derived for periphyton.

TABLE 9-3

Comparisons of 1981 Water Year vs. Baseline
for Mean Values of Major Water Quality Constituents
Values are in mg/l

Baselines are mean values

| | WU07 | | WU22 | | WU58 | | WU61 | |
|---|---|---|---|---|---|---|---|---|
| | 1980-1981 | Baseline | 1980-1981 | Baseline | 1980-1981 | Baseline | 1980-1981 | Baseline |
| Alk | 460 | 422 | - | 403 | 435 | 402 | 538 | 465 |
| $NH_3$ | 0.06 | 0.04 | 0.07 | 0.02 | 0.06 | 0.02 | 0.09 | 0.03 |
| As | 0.0026 | 0.0024 | 0.0015 | 0.0010 | 0.0016 | 0.0011 | 0.0027 | 0.0023 |
| B | 0.218 | 0.209 | 0.095 | 0.108 | 0.133 | 0.210 | 0.245 | 0.214 |
| Ca | 71 | 69 | 87 | 93 | 84 | 92 | 68 | 78 |
| Cl | 16.3 | 15 | 6.5 | 7.2 | 12.2 | 11.5 | 11.6 | 14 |
| F | 1.0 | 0.9 | 0.3 | 0.3 | 0.4 | 0.4 | 2.2 | 0.9 |
| Mg | 49 | 46 | 72 | 76 | 69 | 76 | 62 | 67 |
| Mn | 92 | 46 | 9 | 10 | 8 | 14 | 43 | 66 |
| DOC | - | - | - | - | - | - | - | - |
| K | 2.8 | 3.6 | 1.3 | 1.6 | 1.6 | 2.2 | 2.9 | 3.5 |
| Si | 16 | 15 | 16 | 15 | 16 | 15 | 19 | 17 |
| Na | 134 | 122 | 123 | 124 | 119 | 128 | 191 | 150 |
| TDS | 750 | 692 | 905 | 936 | 851 | 926 | 963 | 902 |
| $SO_4$ | 193 | 164 | 359 | 368 | 318 | 356 | 309 | 290 |

Station values in 1980-1981 are for the months of 10/80 to 9/81 from USGS water data.

Baseline values are for the period 11/74 to 10/76 - from environmental baseline program.

TABLE 9-4

Downstream-to-Upstream* Ratios
of 12-Month Means, October 1-October 1

| | 1979-1980, WU61/WU07 | 1980-1981 WU61/WU07 | Baseline, WU61/WU07 |
|---|---|---|---|
| Alk | 1.06 | 1.17 | 1.10 |
| $NH_3$ | 1.75 | 1.43 | 0.75 |
| As | 0.97 | 1.03 | 0.96 |
| B | 1.02 | 1.12 | 1.02 |
| Ca | 1.03 | 0.95 | 1.13 |
| Cl | 0.99 | 0.71 | 0.93 |
| F | 1.00 | 2.23 | 1.00 |
| Mg | 1.20 | 1.26 | 1.46 |
| Mn | 0.76 | 0.47 | 1.43 |
| K | 1.09 | 1.05 | 0.97 |
| Si | 1.00 | 1.20 | 1.13 |
| Na | 1.15 | 1.43 | 1.23 |
| $SO_4$ | 1.36 | 1.61 | 1.77 |
| TDS | 1.17 | 1.28 | 1.30 |

*Station WU61 is on Piceance Creek, downstream of the Tract;
Station WU07 is on Piceance Creek, upstream of the Tract.

### 9.3.5 Air Quality

Figure 9-10 shows the air quality monitoring network; Station AB26 came on line in October, as a pristine or control site under prevailing winds inasmuch as AB23 has been impacted (primarily particulates from site construction).

Compliance with Federal and State air quality standards continued to be maintained on the C-b Tract during 1981 as indicated in Table 9-5. Data for the most recent three year period are of most interest and are those shown.

Possible linear trends in air quality variables over time have been examined for the 1981 time period (called short-term) and since baseline (long-term) and are summarized in Table 9-6. Entry number 3 for each variable is the computed level of significance; if it is less than the selected level of 0.05, a trend exists at this level of significance. Entries 3 and 4 are shown only for significant trends. Negative long-term trends (slopes) continue to exist for carbon monoxide probably due to the higher readings exhibited in baseline and shortly thereafter utilizing a relatively inaccurate instrument; CO mean values are near 400 ug/$m^3$ compared to the 8-hour standard of 10,000 ug/$m^3$ so that trends of -0.5 ug/$m^3$/month are negligible.

Visual range measurements at the Tract have exhibited essentially no decrease since their inception in 1975.

### 9.3.6 Meteorology

Figures 9-11a and 9-11b show the climatological network. Meteorological data collected in 1981 are generally consistent with those of prior years. Peak precipitation events compare as follows (cm):

| | 1979-1980 | 1980-1981 |
|---|---|---|
| 1-hour | 1.1 | 1.1 |
| 24-hour | 2.0 | 2.1 |
| Month | 6.6 | 10.1 |

### 9.3.7 Noise

Environmental noise has increased over baseline due to Tract activities. Peak values of approximately 80 dBA were reached during 1981, a value equal to the State noise standard for an industrial zone. The Tract is not classified as industrial, however.

### 9.3.8 Wildlife Biology

Figure 9-12 presents the biological network also showing areas of the sprinkler (land application) system. Sampling protocol and locations are discussed in Volume 2.

Deer pellet group densities were lower in 1980-1981 than in 1979-1980. Development activities have not significantly affected pellet group densities. Relatively heavy deer losses in 1980-1981 were due to the severe winter.

TABLE 9-5
Comparisons of Maximum Background Levels with Ambient Standards (Station AB23)

| Applicable Standard | Constituent | Averaging Time | Standard Limit ($ug/m^3$) | Maximum Reading ($ug/m^3$) 1979 | 1980 | 1981 |
|---|---|---|---|---|---|---|
| Colorado Ambient Air Quality Standards | Particulates | Annual | 75 | 18.0 | 8.3 | 15.3 |
| | Particulates | 24-Hour | 260 | 99.8 | 58.4 | 86.2 |
| | $H_2S$ | 1-Hour | 142 | 12.0 | 19.0 | 8.0 |
| National Ambient Air Quality Standards | | | | | | |
| Primary | $SO_2$ | Annual | 80 | 0.4 | 1.0 | 1.5 |
| | | 24-Hour | 365 | 7.6 | 11.9 | 17.3 |
| Secondary | $SO_2$ | 3-Hour | 1300 | 16.4 | 13.1 | 18.3 |
| Primary | $NO_2$ | Annual | 100 | 2.0 | 1.0 | 2.7(1) |
| Primary | Particulates | Annual | 75* | 13.3 | 8.3 | 10.6 |
| | | 24-Hour | 260 | 99.8 | 58.4 | 86.2 |
| Secondary | Particulates | Annual | 60* | 13.3 | 8.3 | 10.6 |
| | | 24-Hour | 150 | 99.8 | 58.4 | 86.2 |
| Primary | CO | 8-Hour | 10,000 | 1700 | 3000 | 1800 |
| | | 1-Hour | 40,000 | 2900 | 3800 | 1800 |
| Primary | Oxidant | 1-Hour | 240(2) | 245.8(3) | 153.6 | 155.0 |

*Geometric Mean
(1) 50% Data
(2) Standard is exceeded if $\geq$ 3 expected exceedances occur above this value over a three year interval.
(3) Represents the only exceedance to date

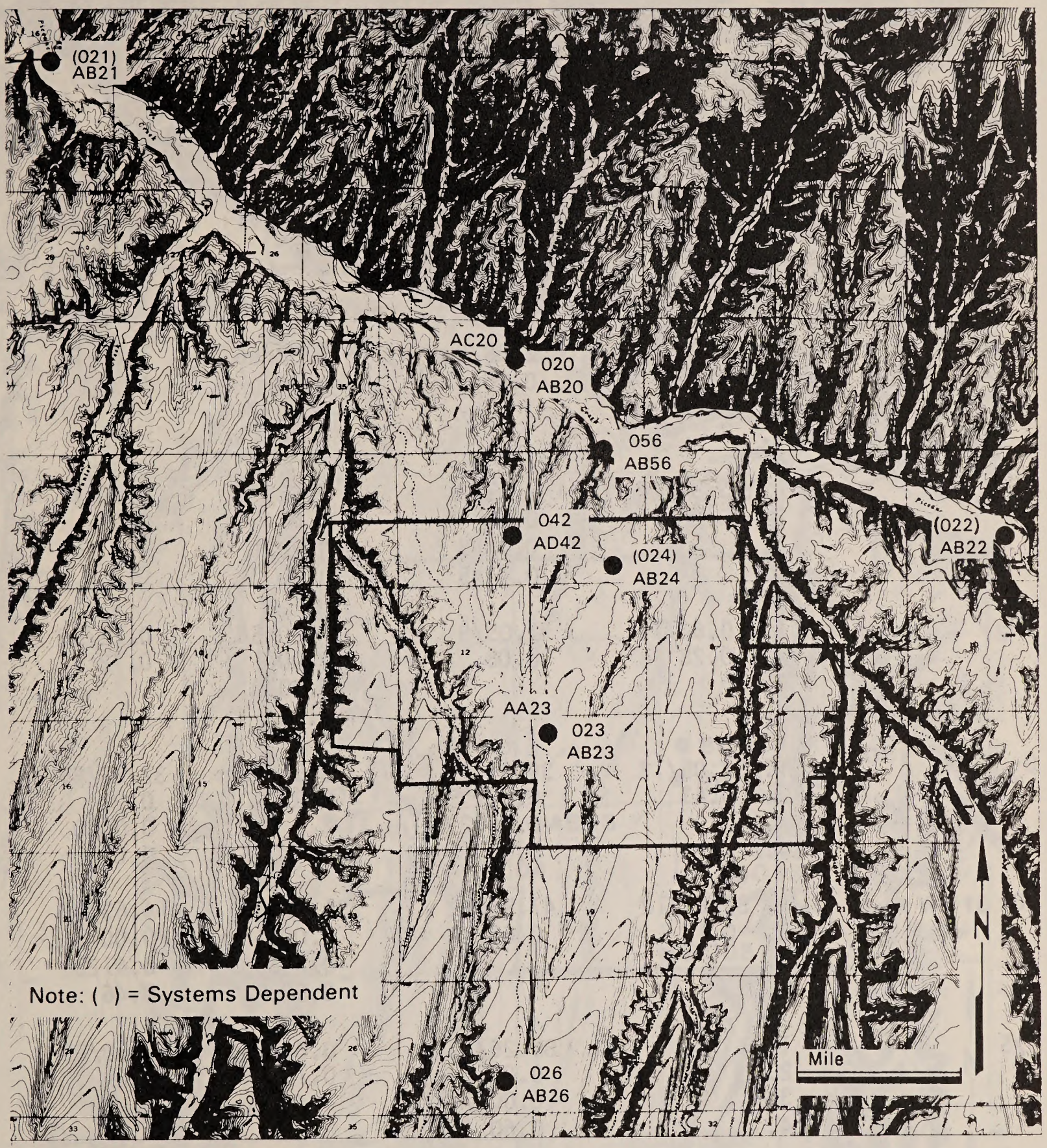



Figure 9-10
Ambient Air Quality Development Monitoring Network

TABLE 9-6

Summary of Air Quality Trend Analysis, Stations AB20 and AB23
Units are ug/$m^3$

| Indicator Variable | | Short-Term 020 | Short-Term 023 | Long-Term 020 | Long-Term 023 |
|---|---|---|---|---|---|
| $SO_2$ | 1.* | 1.41/12 | 0.61/12 | 0.28/71 | 0.10/86 |
| | 2. | 0.20 | 0.74 | 0.80 | 0.14 |
| | 3. | | | | |
| | 4. | | | | |
| NOX | 1. | 1.35/12 | 2.88/9 | 3.63/66 | 1.40/80 |
| | 2. | 0.23 | 0.06 | 0.002 | 0.36 |
| | 3. | | | -0.0032 | |
| | 4. | | | 0.14 | |
| NO | 1. | 0.89/12 | 2.02/9 | 2.36/66 | 0.90/81 |
| | 2. | 0.08 | 0.04 | 0.01 | 0.35 |
| | 3. | | 0.0143 | -0.0021 | |
| | 4. | | 0.4745 | 0.09 | |
| $NO_2$ | 1. | 0.62/12 | 1.05/9 | 1.30/66 | 0.72/80 |
| | 2. | 0.28 | 0.08 | 0.0001 | 0.72 |
| | 3. | | | -0.0010 | |
| | 4. | | | 0.22 | |
| $O_3$ | 1. | 33.05/12 | 39.21/12 | 28.56/66 | 37.27/85 |
| | 2. | 0.43 | 0.002 | 0.22 | 0.01 |
| | 3. | | -0.0602 | | 0.0030 |
| | 4. | | 0.65 | | 0.07 |
| CO | 1. | 89.87/12 | 47.91/12 | 335.79/59 | 414.63/78 |
| | 2. | 0.13 | 0.66 | 0.0001 | 0.0001 |
| | 3. | | | -0.3635 | -0.4723 |
| | 4. | | | 0.52 | 0.46 |
| $H_2S$ | 1. | | 85.26/11 | 0.06/24 | 0.49/82 |
| | 2. | | 0.005 | 0.75 | 0.04 |
| | 3. | | 0.0067 | | |
| | 4. | | 0.60 | | |
| TSP | 1. | 14.38/12 | 15.76/12 | 12.61/73 | 12.48/88 |
| | 2. | 0.53 | 0.49 | 0.74 | 0.49 |
| | 3. | | | | |
| | 4. | | | | |

1.* Mean/Number of paired observations
2. $\hat{\alpha}$ - to be compared with selected $\alpha$ .( $\alpha = 0.05$); if $\hat{\alpha} < \alpha$, trend exists
3. Slope - slope is (ug/$m^3$) per day
4. $r^2$ value

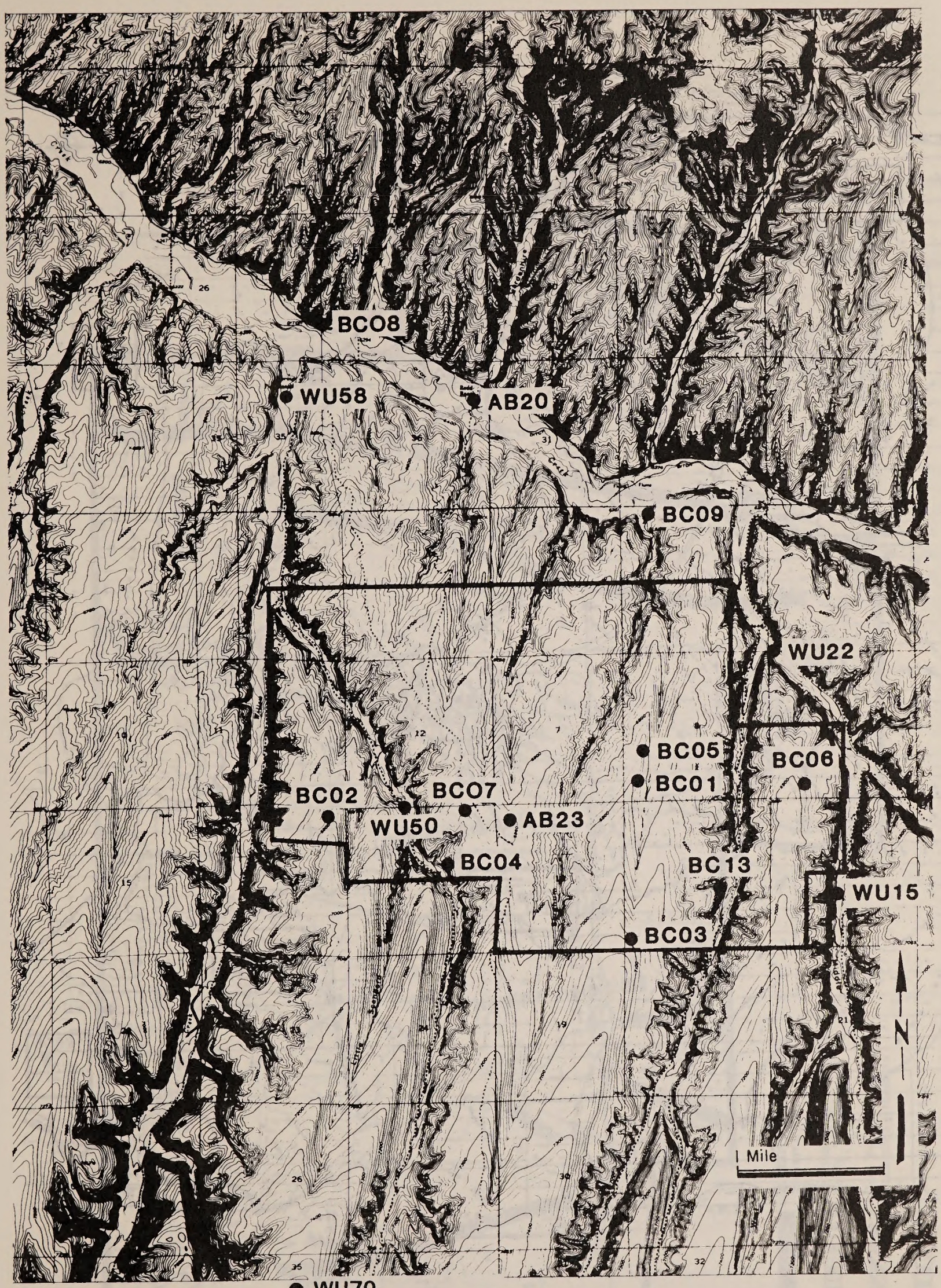



Figure 9-11a
Climatological Network near Tract

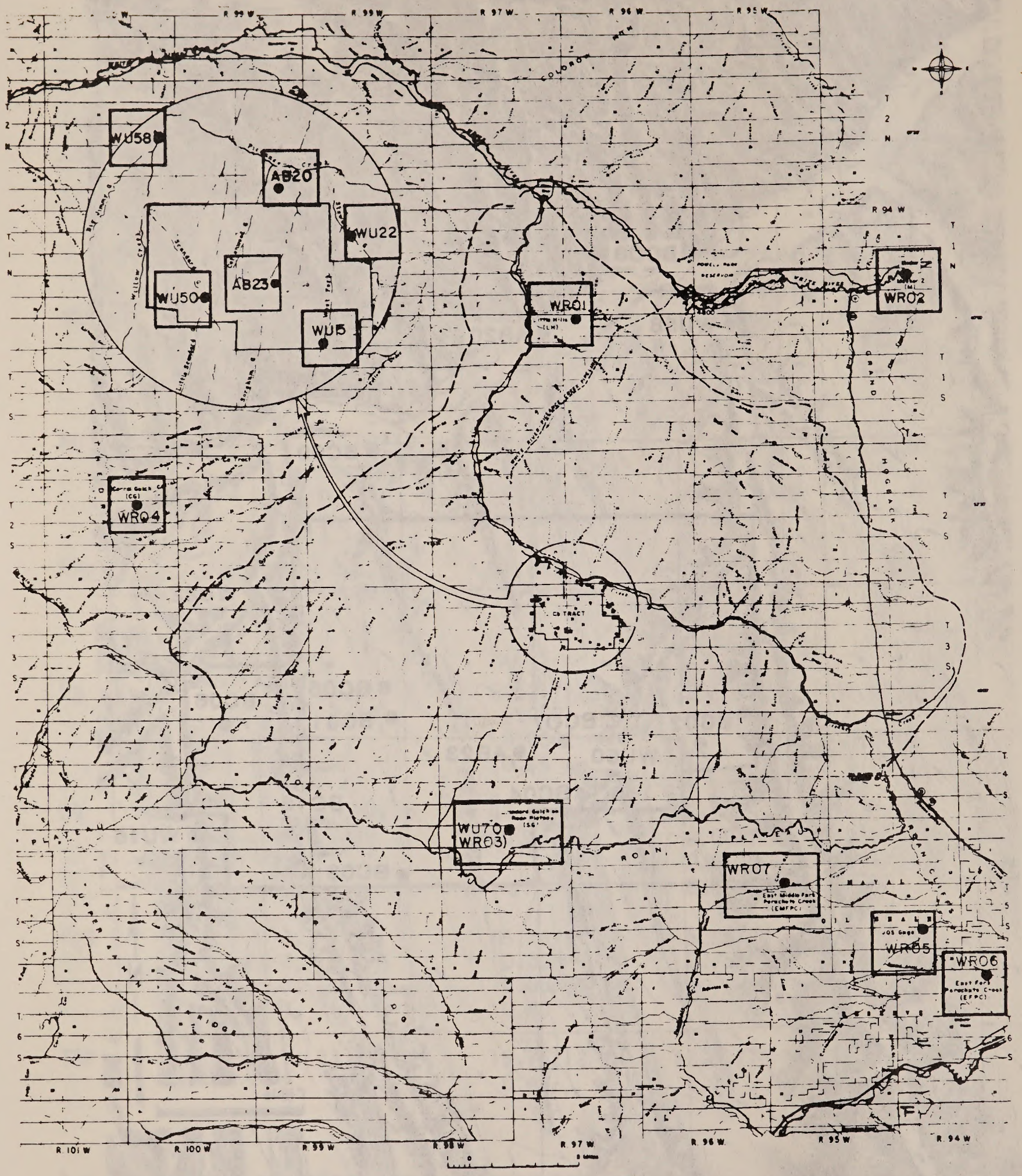



**Figure 9-11b**
**Climatological Network Off-Tract**

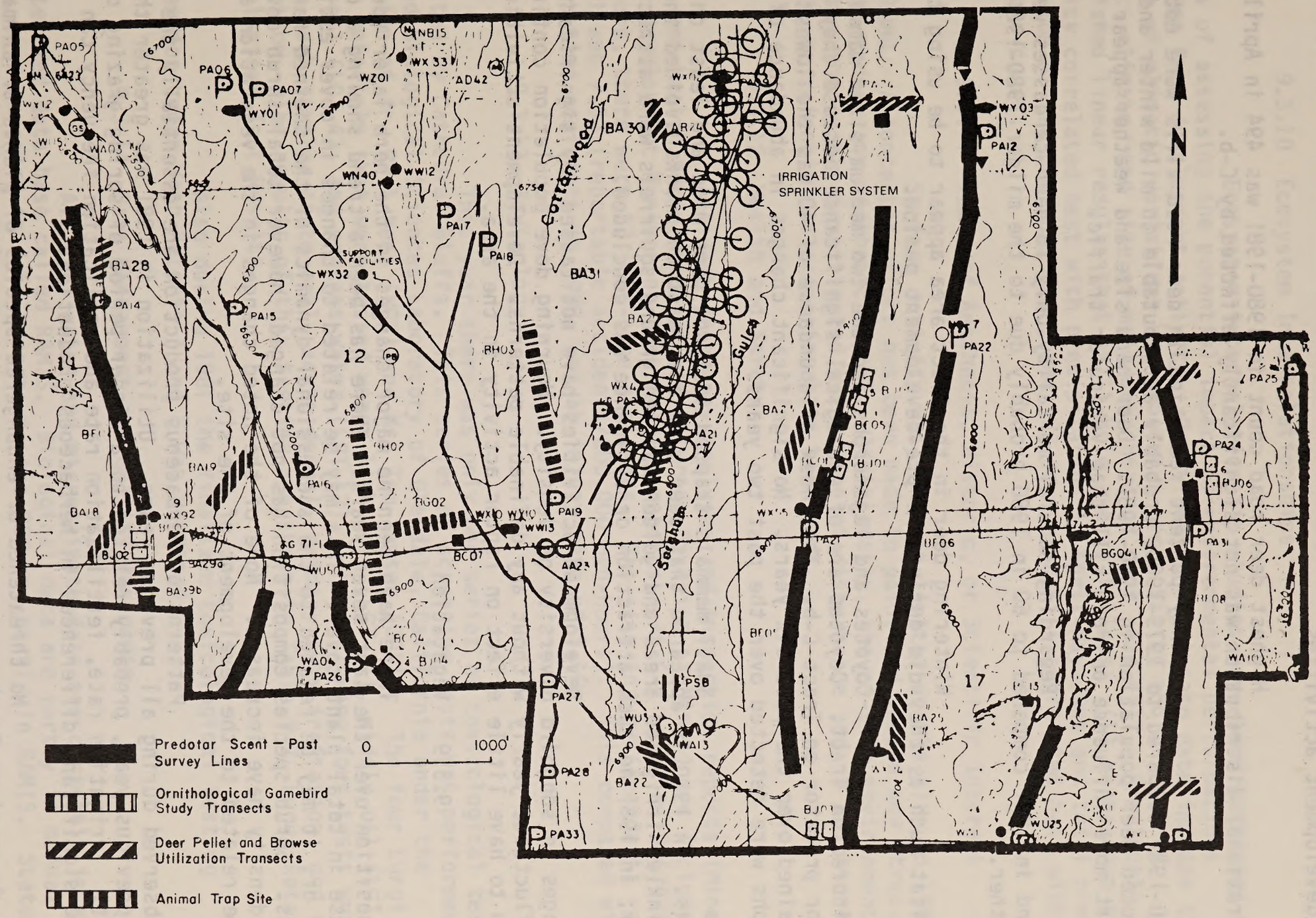



Figure 9-12
Biological Network

Bitterbrush utilization was higher in 1980-1981 than the previous year (72% vs. 61%). Browse utilization was not significantly affected by development activities.

Highest deer road count in 1980-1981 was 494 in April. Migrational distribution was not significantly affected by C-b.

Seventy percent reduction in deer road kills were noted in 1980-1981 compared to 1979-1980, probably attributable to mild winter and reduced deer population in 1980-1981. Deer herd size and weather appear to exert more influence on road kill than vehicular traffic.

Regarding natural mortality only 16 deer carcasses were found in 1981 compared to 60 in 1980 probably due to the milder 1980-1981 weather.

Wintering deer in the Tract area appear to be using the habitat much as they did during the pre-development period.

Coyotes and lagomorphs are the two medium-sized mammals monitored on Tract. Coyotes are of ecological significance because they are a major predator on Tract C-b. The index of abundance of 40 was the lowest obtained over the past six years. No significant changes in abundance of lagomorphs were detected over the past two years.

Small mammals trapped included deer mice and least chipmunks. In 1980 it appeared that deer mice and least chipmunks avoided the sprinkler-irrigated areas and golden-mantled ground squirrels were attracted to them; in 1981 no such attraction or avoidance was concluded.

Development activities have not caused any significant changes in songbird diversity or density. Mourning dove population continues to fluctuate yearly without any definable patterns. Development activities seem to have little effect on raptor activity in the area.

### 9.3.9 Vegetation

There have been no major changes in the herb layer species composition over the last seven years. There has been a trend showing a decrease in total plant cover. This may be related to changes in cover estimation or, it may be related to the successional dynamics of the chained rangelands. Shrub species composition has not changed, however total shrub cover and density have increased. None of the noted changes in the vegetation appear to be related to the development of the site.

Patterns of herbaceous production are essentially the same as observed during all previous years. Utilization in 1981 was greater than any previous year, probably related to a longer period of spring grazing on Tract. Irrigation rate, fertilization rate and application frequency can all cause significant differences in herbaceous production.

No threatened or endangered species of plants or animals were observed on Tract.

Revegetation success of the topsoil piles has been achieved regarding herbaceous cover, diversity and productivity.

### 9.3.10 Ecosystem Interrelationships

Ecosystem interrelationship studies have been continued as a means of assessing the potential impact of environmental perturbations resulting from development activity. Quantitative studies to date include the effects of climatic variations on herbaceous productivity and effects of traffic, climate, and size of mule-deer herd on deer road-kill. Previously established linear results that still hold are as follows: (1) herbaceous productivity correlated best with precipitation in April-May-June and total precipitation of the previous year; and (2) deer road-kill correlated best with deer road-count.

### 9.3.11 Items of Aesthetic, Historic, or Scientific Interest

Surface activity was somewhat limited at the site in 1981 as in 1980. A concerted effort has been made to paint and locate new structures to reduce any aesthetic impact. Additionally, the on-site environmental staff has thoroughly investigated every site of disturbance and no additional historic or scientific discoveries have been made.

### 9.3.12 Health and Safety

Accident frequency analyses and inspection reports (Mine Safety and Health Administration and Colorado Division of Mines) are included in the Development Monitoring Plan and its reports. At C-b based on 956,636 man-hours, there were 22 lost-time accidents. The site injury (incident) rate in 1981 was 7.53 (reportable accidents/200,000 man-hours). This compared with 15 lost-time accidents in 1980, and an injury rate of 5.10.

### 9.3.13 Toxicology

This year there was only one series of toxicological tests conducted by Cathedral Bluffs. This series of screening tests was performed by Applied Biological Sciences Laboratory of Glendale, California under the direction of Dr. Paul Nees (HCC) and Mr. Tom Samson (OOSI). The four Lurgi Retort materials that were tested were: light oil (LGT-21), middle oil (LGT-5), heavy oil (LGT-4), and process water (LGT-12). The following four tests were run on each sample: acute oral, acute dermal, primary skin irritation, and eye irritation. The results of this testing are shown in Table 9-7, Lurgi Retort Toxicological Test Results.

Also during 1981 the finalized toxicological testing program for Logan Wash Retorts 7 and 8 was prepared.

### 9.3.14 Data Management and Quality Assurance

All air, water and microclimate data are currently in a computerized data base called RAMIS. Biological data are partly in manual data bases, as documented in data reports to the OSO and partly in RAMIS. Status is as indicated in Table 9-8.

TABLE 9-7

Lurgi Retort Toxicological Test Results

| | Acute Oral | Acute Dermal | Primary Skin Irritation | Eye Irritation |
|---|---|---|---|---|
| Light Oil (LGT-21) | Relatively Non-Toxic | Non-Toxic | Slight Irritant | Non-Irritating |
| Middle Oil (LGT-5) | Slightly Toxic | Non-Toxic | Moderate Irritant | Non-Irritating |
| Heavy Oil (LGT-4) | Relatively Non-Toxic | Non-Toxic | Moderate Irritant | Non-Irritating |
| Process Water (LGT-12) | Non-Toxic | Non-Toxic | Non-Irritant | Non-Irritating |

TABLE 9-8

Status of Automated Environmental Data Base

| | Automated |
|---|---|
| **Water Quality** | |
| Springs and Seeps | October, 1974 thru November, 1981 |
| Alluvial Wells | October, 1974 thru November, 1981 |
| Upper Aquifer Wells | October, 1974 thru November, 1981 |
| Lower Aquifer Wells | October, 1974 thru November, 1981 |
| **Wells Water Levels** | |
| Water Levels | October, 1974 thru November, 1981 |
| **Water Augmentation Plan** | |
| Springs and Seeps | July, 1979 thru November, 1981 |
| Upper Aquifer Wells | August, 1979 thru November, 1981 |
| Lower Aquifer Wells | August, 1979 thru November, 1981 |
| Precipitation | January, 1979 thru November, 1981 |
| **National Pollutant Discharge Elimination System** | |
| Water Quality Data | July, 1979 thru November, 1981 |
| **Water Usage** | October, 1974 thru December, 1981 |
| **Well Reinjection** | March, 1981 thru November, 1981 |
| **Air Quality** | |
| Small Stations (Station AD42, AD56) | October, 1974 thru August, 1980 |
| Large Trailer (Station AB20) | October, 1974 thru October, 1976<br>July 1978 thru October 1981 |
| Large Trailer (Station AB23) | October, 1974 thru October, 1981 |
| Meteorological Tower (Station AA23) | October, 1974 thru October, 1981 |
| **Traffic** | February, 1980 thru November, 1981 |
| **Biology** | |
| Microclimate | October, 1974 thru November, 1981 |
| Deer Kill | October, 1974 thru November, 1981 |
| Deer Count | September, 1977 thru November, 1981 |
| Avifauna | 1977 thru 1981 |

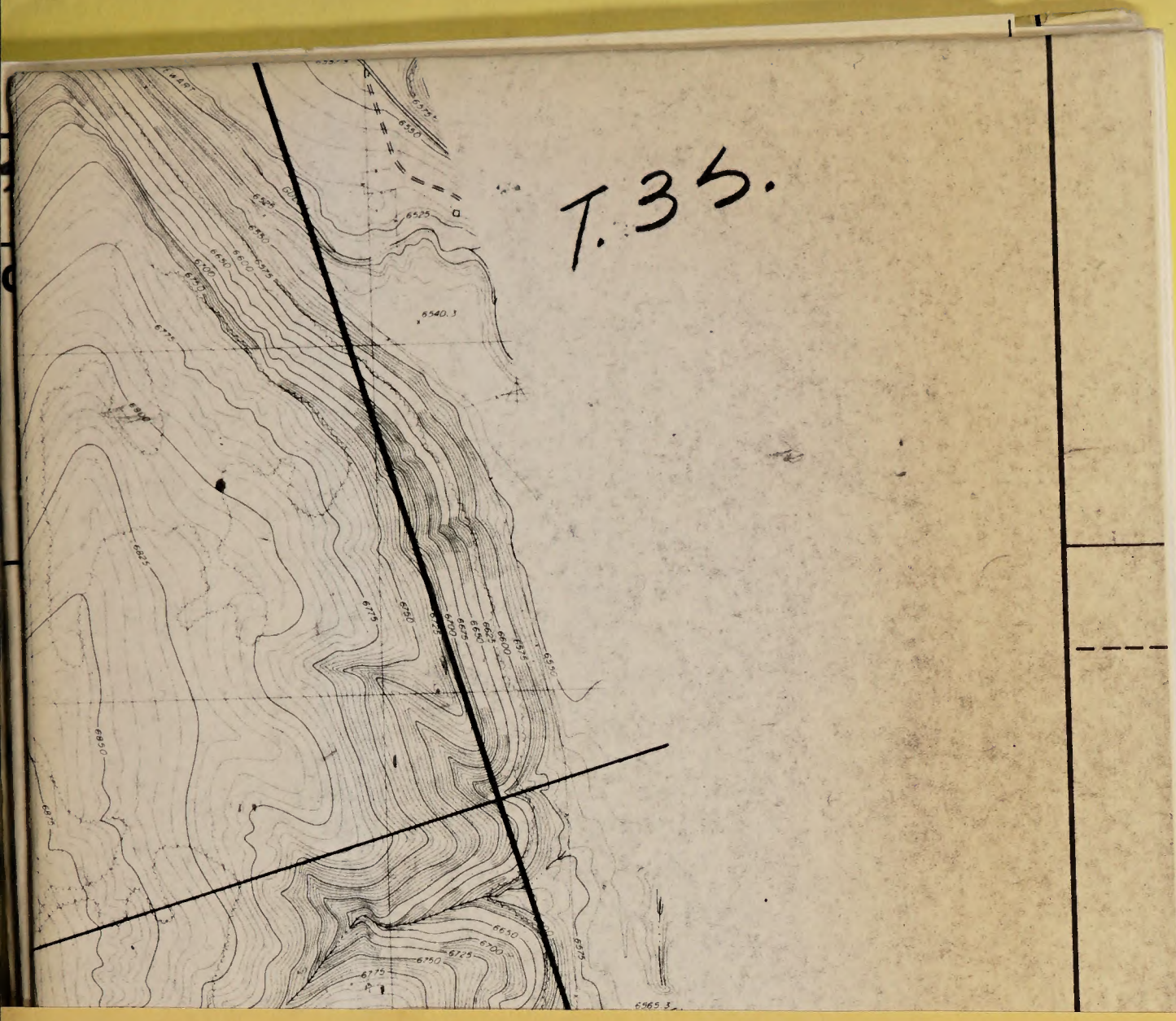
Data collected and analyzed by USGS for stream flow and stream water quality are stored in government computer data bases in Reston, Virginia. These data bases (WATSTOR) and (NAWDEX) are accessed by dialing computer communications for retrievals of data to the Occidental Grand Junction computers for printing and analysis.

Data tapes for air quality and meteorology have been furnished to the OSO for data through November, 1981.

Extensive quality assurance (QA) documents for air and water were prepared in 1981 and procedures implemented in the field programs. Two QA audits for air were conducted in 1981.

### 9.3.15 Reporting

Annual reports are submitted during the anniversary month of the Lease (April). Semi-annual Data reports are submitted to the OSO on January 15 and July 15. Air quality data volumes in these reports are also submitted to EPA, Region VIII, and the Air Quality Control Division of the Colorado Department of Health.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15. PROCESS FACILITY
16. WATER TREATING FACILITY
17. CUT BANK MATERIAL AREA
18. POND "C" PIPELINE
19. IRRIGATION PIPELINE
20. REINJECTION PIPELINE
• CORE HOLES COMPLETED
⊗ CORE HOLES PERMITTED
——— PERMITTED & DISTURBED AREAS
— — PERMITTED AREAS

21. REINJECTION POND (POND "D")
22. REINJECTION STATION
23. DRILL PADS & ROADS

LEGEND:

1. GUARD HOUSE & TRUCK SCALE AREA
2. SEWAGE TREATMENT PLANT
3. HELI-PORT & PUBLIC RELATIONS TRAILER
4. MAIN ACCESS ROAD
5. ANCILLARY AREA
6. PROPOSED DAM SITE (EAST NO NAME)
7. FILL MATERIAL AREA
8. EXPLOSIVE STORAGE AREA
9. MINE SUPPORT AREA
10. RAW SHALE DISPOSAL AREA
11. ROCK STOCKPILE AREA
12. TOPSOIL STOCKPILE AREA
13. WATER DISCHARGE & APPLICATION AREA, (POND "C")

14. ABANDONED ACCESS ROAD

▨ RECLAIMED AREAS

T. 35.

5 8 9 7 16 17

31X-8 32X-6 34X-8 22X-17

19 23


D

E

THESE DRAWINGS WERE COMPILED USING AERIAL METHODS AND PHOTOGRAPHY TAKEN ON AUG. 27, 1980.

GROUND SURVEY CONTROL BY CONSTRUCTION SURVEYS, INC. RIFLE, COLORADO.

PHOTOGRAMMETRIC SERVICES BY SCHARF AND ASSOCIATES, DENVER, COLORADO.

SCALE 1" = 600'

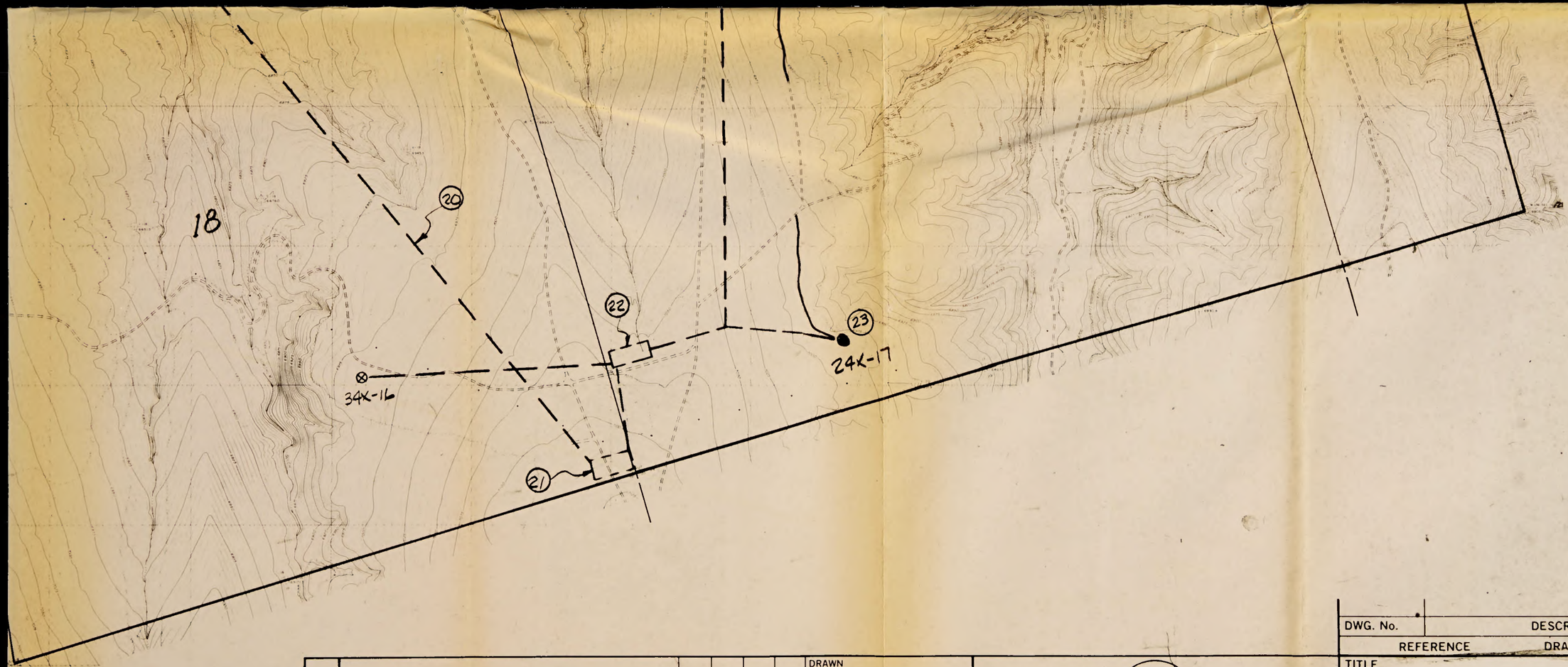
600 0 600 1200 1800

18° 00' 05"

STATE PLANE GRID NORTH

PLANT GRID NORTH

1/10 | 1/8 – 1/4 | 3/8 – 3/4 | 1/2 – 1




| REV. | DESCRIPTION | DRAWN | DATE | CHK'D | APPR. | APPROVALS |
|---|---|---|---|---|---|---|
| | | | | | | DRAWN DATE |
| 3 | INCORPORATED DWGS. 634606-4-SR-0002 AD-0037, AD-0011, AD-0038 | NH | 1/6/82 | | | CHECKED DATE |
| 2 | Added Range, Township & Section Lines | NH | 5/14/81 | JED | | APPROVED ENG. |
| 1 | Added 14 & Rec. Area Design. | NH | 4/29/81 | JED | | APPROVED |
| 0 | | JED | 2/10/81 | | | APPROVED |

Cathedral Bluffs Shale Oil Company

PROJECT No.

SCALE 1" = 600'

| DWG. No. | DESCRIPTION |
|---|---|
| REFERENCE | DRAWINGS |

TITLE

# FIGURE 6-1
# C-b TRACT
# DISTURBED AREAS MAP

DRAWING No. AD-0039

REV. 2

D

FOLD

E

FOLD

1

2

3

A

B

C

230

231

E. 1,232,000

233

234

235

E. 1,236,000

237

238

239

E. 1,240,000

241

188

187

186

185

184,000

FIGURE 4-3

FIGURE 4-5

FIGURE 4-2

4

5

6

7

A

B

C

242

243

E. 1,244,000

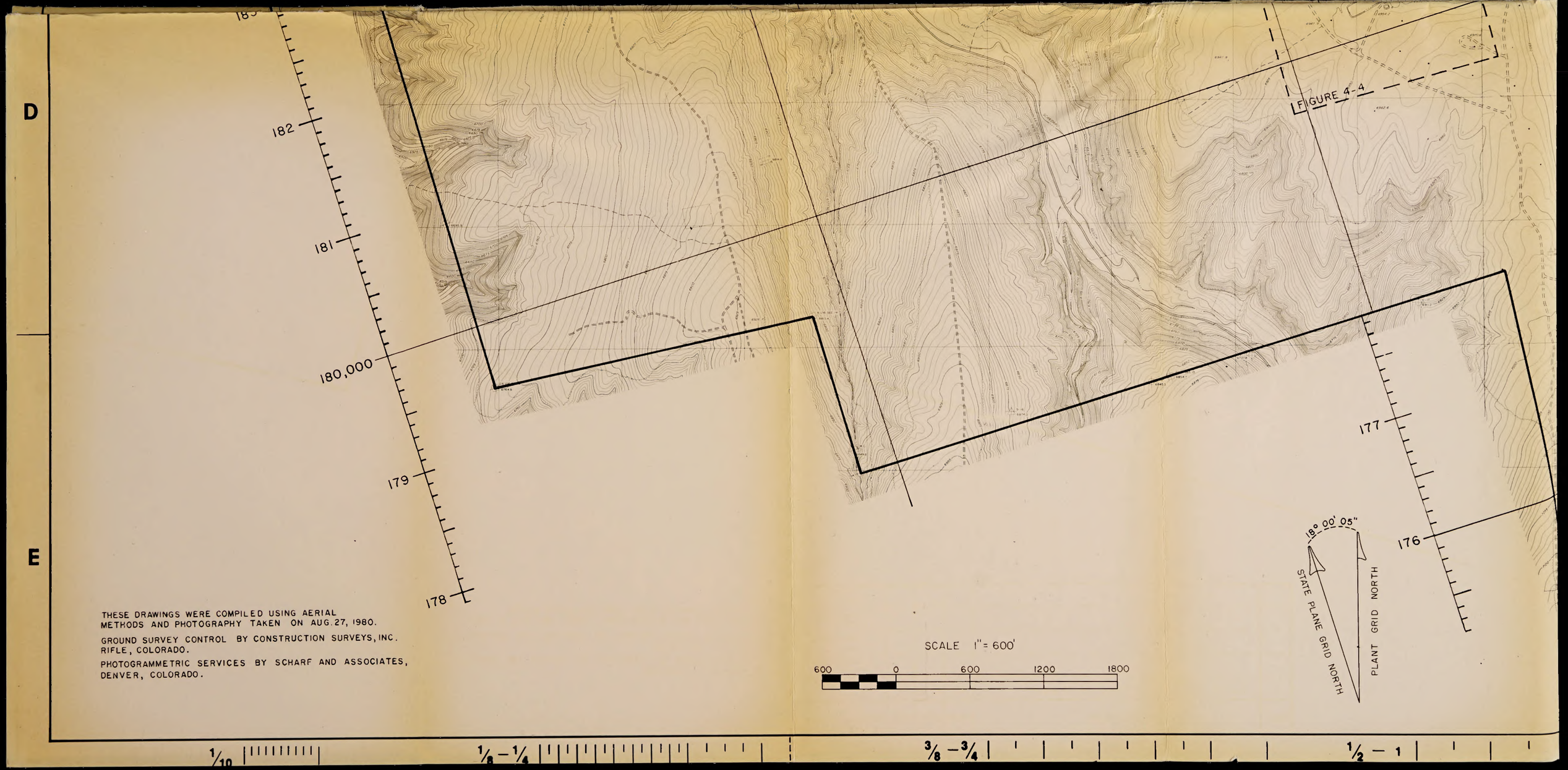
245

246

247

E. 1,248,000

249


D
E
182
181
180,000
179
178
177
176
FIGURE 4-4
18° 00' 05"
STATE PLANE GRID NORTH
PLANT GRID NORTH
SCALE 1" = 600'
600
0
600
1200
1800
THESE DRAWINGS WERE COMPILED USING AERIAL METHODS AND PHOTOGRAPHY TAKEN ON AUG. 27, 1980.
GROUND SURVEY CONTROL BY CONSTRUCTION SURVEYS, INC. RIFLE, COLORADO.
PHOTOGRAMMETRIC SERVICES BY SCHARF AND ASSOCIATES, DENVER, COLORADO.
1/10
1/8 – 1/4
3/8 – 3/4
1/2 – 1

D

FOLD

E

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | DRAWN DATE |
| | | | | | | CHECKED OATE |
| | | | | | | APPROVEO ENG. |
| | | | | | | APPROVED |
| 1 | GRID & FIGURE Areas Outlined | VS | 4/1/82 | | | APPROVED |
| REV. | DESCRIPTION | DRAWN | DATE | CHK'D. | APPR. | APPROVALS |

Cathedral Bluffs Shale Oil Company

PROJECT No. ESF-13.3

SCALE 1"=600'

| | |
|---|---|
| AD-0018 | AREA MASTER INDEX |
| DWG. No. | DESCRIPTION |
| REFERENCE | DRAWINGS |

TITLE

# FIGURE 4-1
# C-b TRACT
# TOPOGRAPHIC MAP

DRAWING No. AD-0017

REV. P

FOLD